

**WiFi 802.11b 1Mbps Right Tilt Channel 11**

Date/Time: 2011-5-26 11:59:02

Electronics: DAE4 Sn771

Medium: Head 2450 MHz

Medium parameters used (interpolated):  $f = 2462$  MHz;  $\sigma = 1.84$  mho/m;  $\epsilon_r = 39.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature: 23.0 °C      Liquid Temperature: 22.5 °C

Communication System: WLAN 2450 Frequency: 2462 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3617 ConvF(7.19, 7.19, 7.19)

**Tilt High/Area Scan (61x101x1):** Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.534 mW/g

**Tilt High/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 14.3 V/m; Power Drift = -0.034 dB

Peak SAR (extrapolated) = 0.787 W/kg

**SAR(1 g) = 0.435 mW/g; SAR(10 g) = 0.221 mW/g**

Maximum value of SAR (measured) = 0.472 mW/g

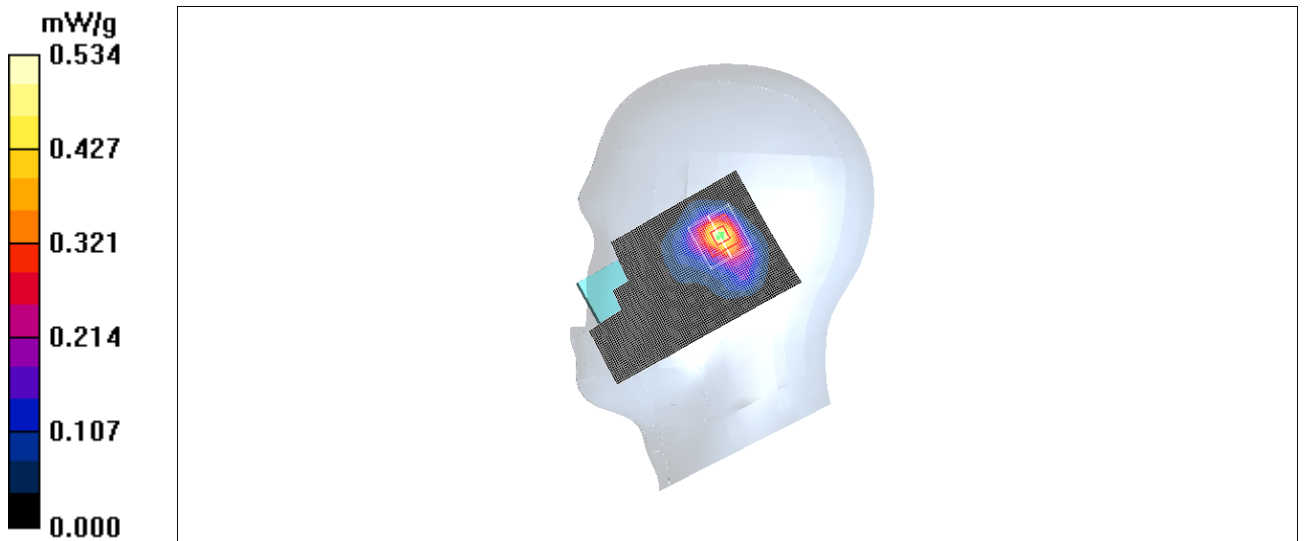


Fig.48 802.11b 1Mbps CH11

**WiFi 802.11b 1Mbps Toward Ground Channel 11**

Date/Time: 2011-5-26 08:11:13

Electronics: DAE4 Sn771

Medium: Body 2450 MHz

Medium parameters used (interpolated):  $f = 2462$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 51.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature: 23.0 °C      Liquid Temperature: 22.5 °C

Communication System: WLAN 2450 Frequency: 2462 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3617 ConvF(6.88, 6.88, 6.88)

**Toward Ground High/Area Scan (61x101x1):** Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.096 mW/g

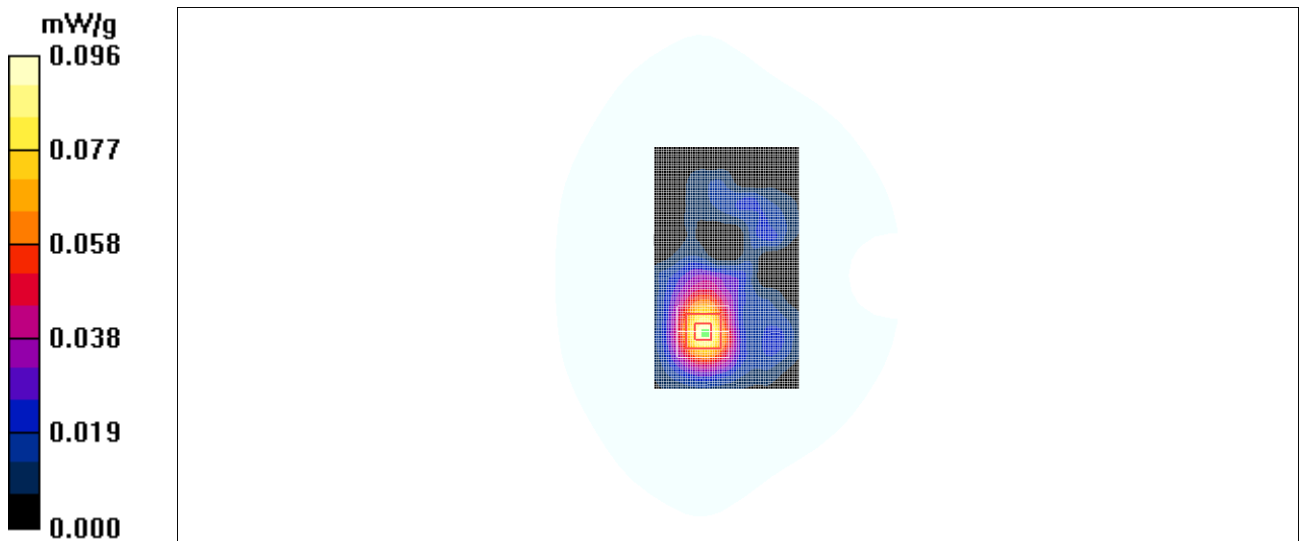
**Toward Ground High/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 3.56 V/m; Power Drift = -0.182 dB

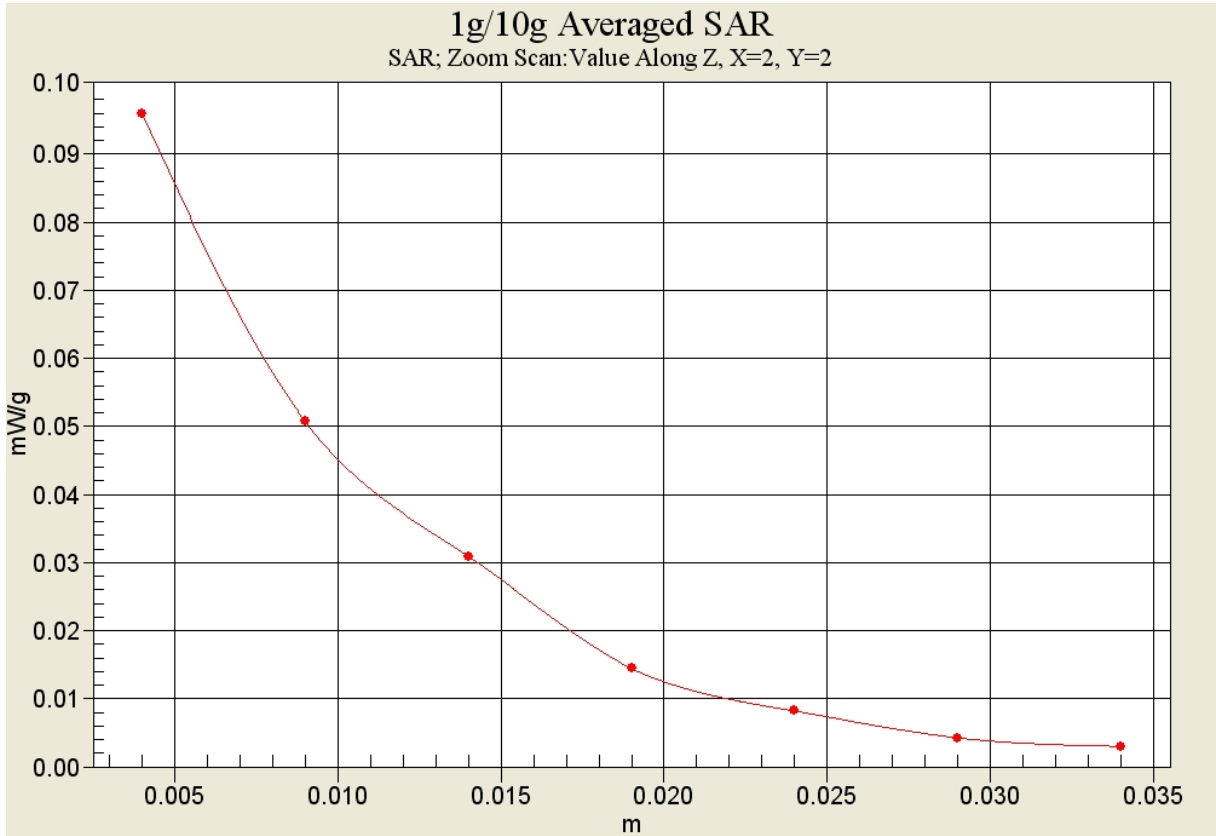
Peak SAR (extrapolated) = 0.162 W/kg

**SAR(1 g) = 0.087 mW/g; SAR(10 g) = 0.047 mW/g**

Maximum value of SAR (measured) = 0.096 mW/g



**Fig.49 802.11b 1Mbps CH11**



**Fig. 49-1 Z-Scan at power reference point (2462 MHz CH11)**

**WiFi 802.11b 1Mbps Toward Phantom Channel 11**

Date/Time: 2011-5-26 08:26:47

Electronics: DAE4 Sn771

Medium: Body 2450 MHz

Medium parameters used (interpolated):  $f = 2462$  MHz;  $\sigma = 1.98$  mho/m;  $\epsilon_r = 51.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature: 23.0 °C      Liquid Temperature: 22.5 °C

Communication System: Wlan 2450 Frequency: 2462 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3617 ConvF(6.88, 6.88, 6.88)

**Toward Phantom High/Area Scan (61x101x1):** Measurement grid: dx=10mm, dy=10mm  
Maximum value of SAR (interpolated) = 0.096 mW/g

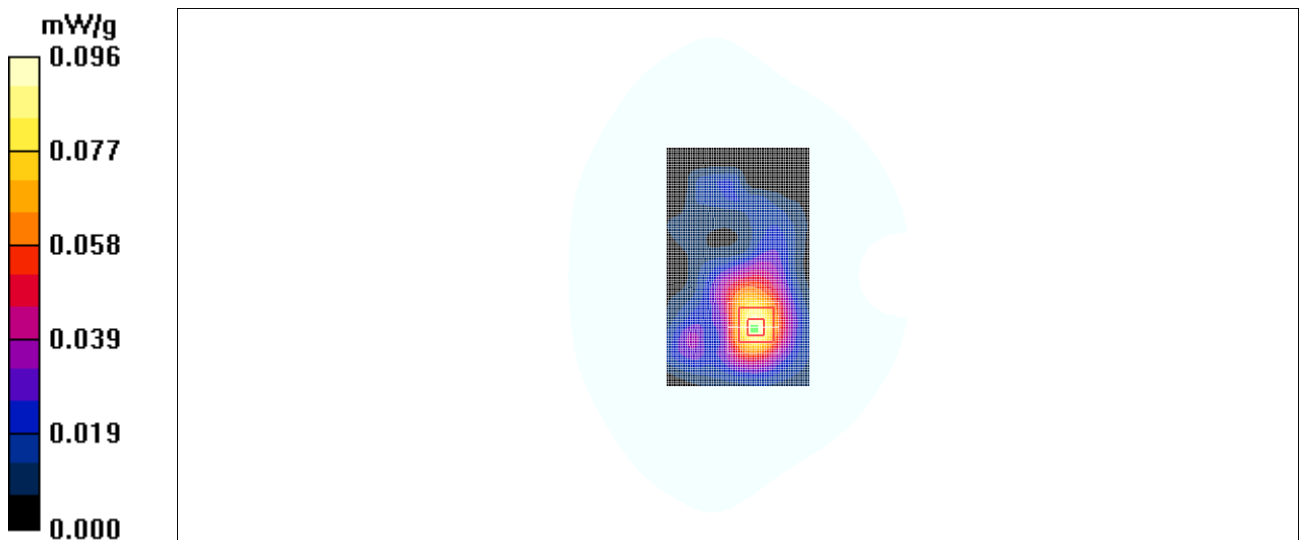
**Toward Phantom High/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 4.78 V/m; Power Drift = -0.124 dB

Peak SAR (extrapolated) = 0.144 W/kg

**SAR(1 g) = 0.081 mW/g; SAR(10 g) = 0.046 mW/g**

Maximum value of SAR (measured) = 0.087 mW/g



**Fig.50 802.11b 1Mbps CH11**

## ANNEX D SYSTEM VALIDATION RESULTS

### 835MHz

Date/Time: 2011-5-27 7:30:19

Electronics: DAE4 Sn771

Medium: Head 850 MHz

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.91$  mho/m;  $\epsilon_r = 41.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature: 23.0°C      Liquid Temperature: 22.5°C

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

Probe: ES3DV3 - SN3149 ConvF(6.56, 6.56, 6.56)

**System Validation /Area Scan (101x101x1):** Measurement grid: dx=10mm, dy=10mm  
Maximum value of SAR (interpolated) = 2.55 mW/g

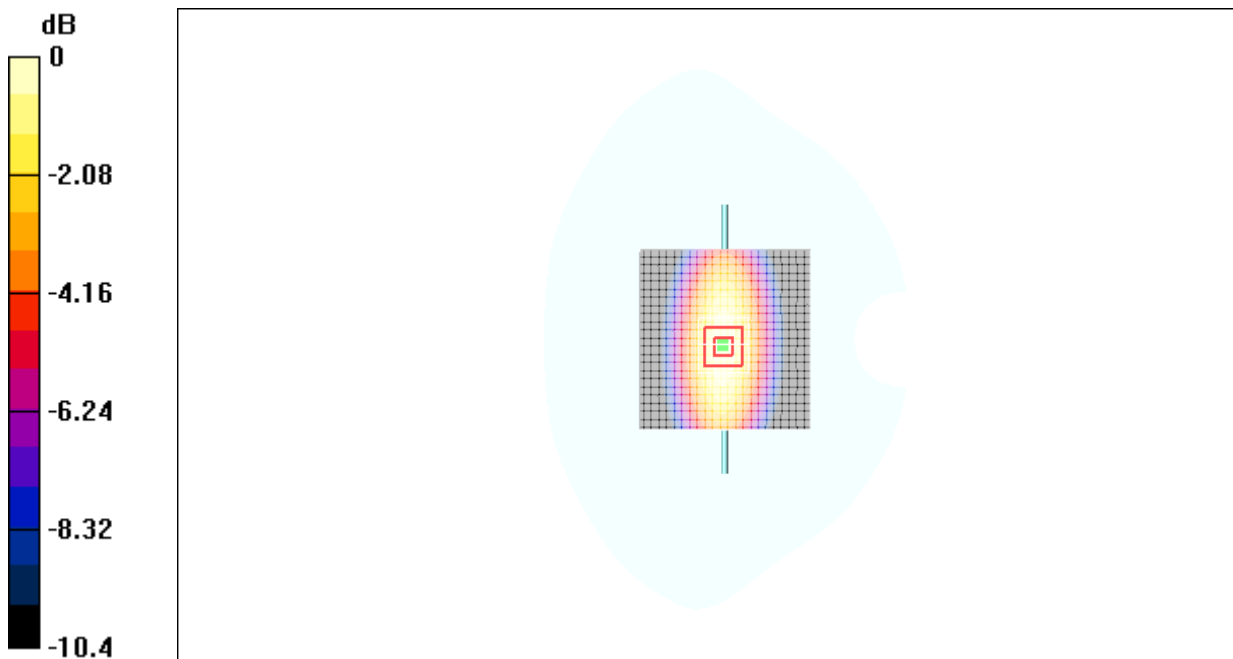
**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.8 V/m; Power Drift = 0.098 dB

Peak SAR (extrapolated) = 3.40 W/kg

**SAR(1 g) = 2.34 mW/g; SAR(10 g) = 1.50 mW/g**

Maximum value of SAR (measured) = 2.47 mW/g



0 dB = 2.47mW/g

**Fig.51 validation 835MHz 250mW**

## 835MHz

Date/Time: 2011-5-27 13:18:31

Electronics: DAE4 Sn771

Medium: Body 850 MHz

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.96 \text{ mho/m}$ ;  $\epsilon_r = 54.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature:  $23.0^\circ\text{C}$       Liquid Temperature:  $22.5^\circ\text{C}$

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

Probe: ES3DV3 - SN3149 ConvF(6.22, 6.22, 6.22)

**System Validation /Area Scan (101x101x1):** Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$   
Maximum value of SAR (interpolated) = 2.61 mW/g

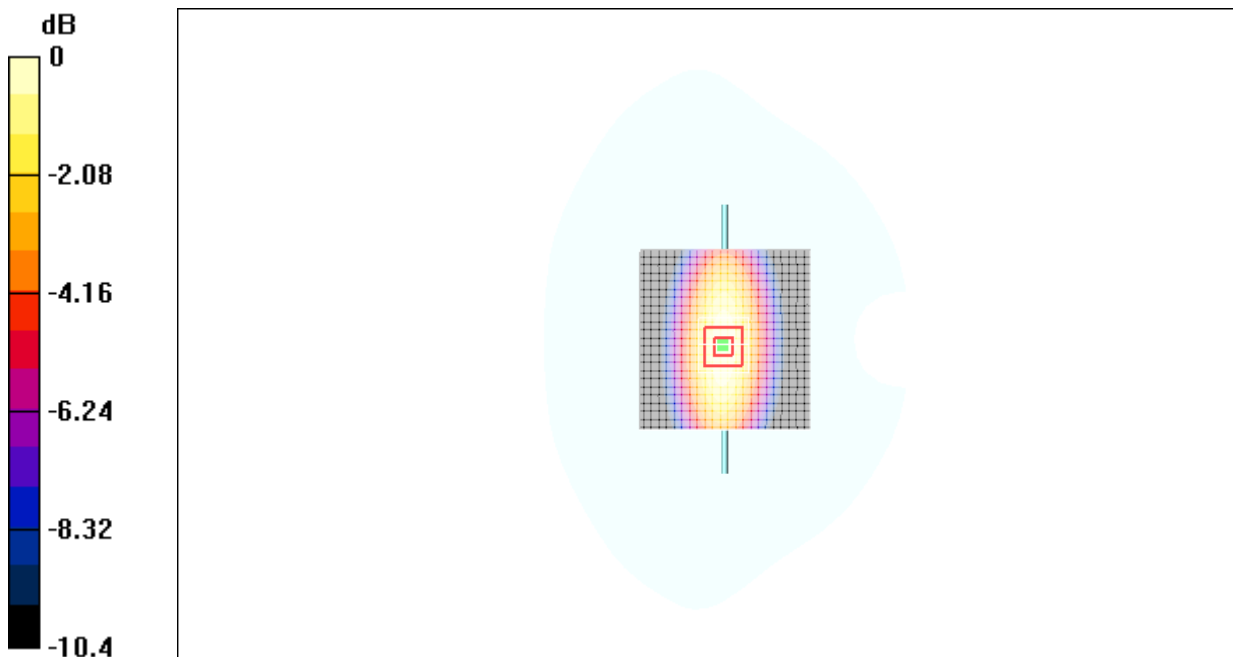
**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  
 $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 52.5 V/m; Power Drift = 0.103 dB

Peak SAR (extrapolated) = 3.44 W/kg

**SAR(1 g) = 2.42 mW/g; SAR(10 g) = 1.56 mW/g**

Maximum value of SAR (measured) = 2.49 mW/g



0 dB = 2.49mW/g

**Fig.52 validation 835MHz 250mW**

## 1900MHz

Date/Time: 2011-5-28 13:21:29

Electronics: DAE4 Sn771

Medium: Head 1900 MHz

Medium parameters used:  $f = 1900 \text{ MHz}$ ;  $\sigma = 1.41 \text{ mho/m}$ ;  $\epsilon_r = 40.7$ ;  $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature:  $23.0^\circ\text{C}$       Liquid Temperature:  $22.5^\circ\text{C}$

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

Probe: ES3DV3 - SN3149 ConvF(5.03, 5.03, 5.03)

**System Validation/Area Scan (101x101x1):** Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$   
Maximum value of SAR (interpolated) =  $11.4 \text{ mW/g}$

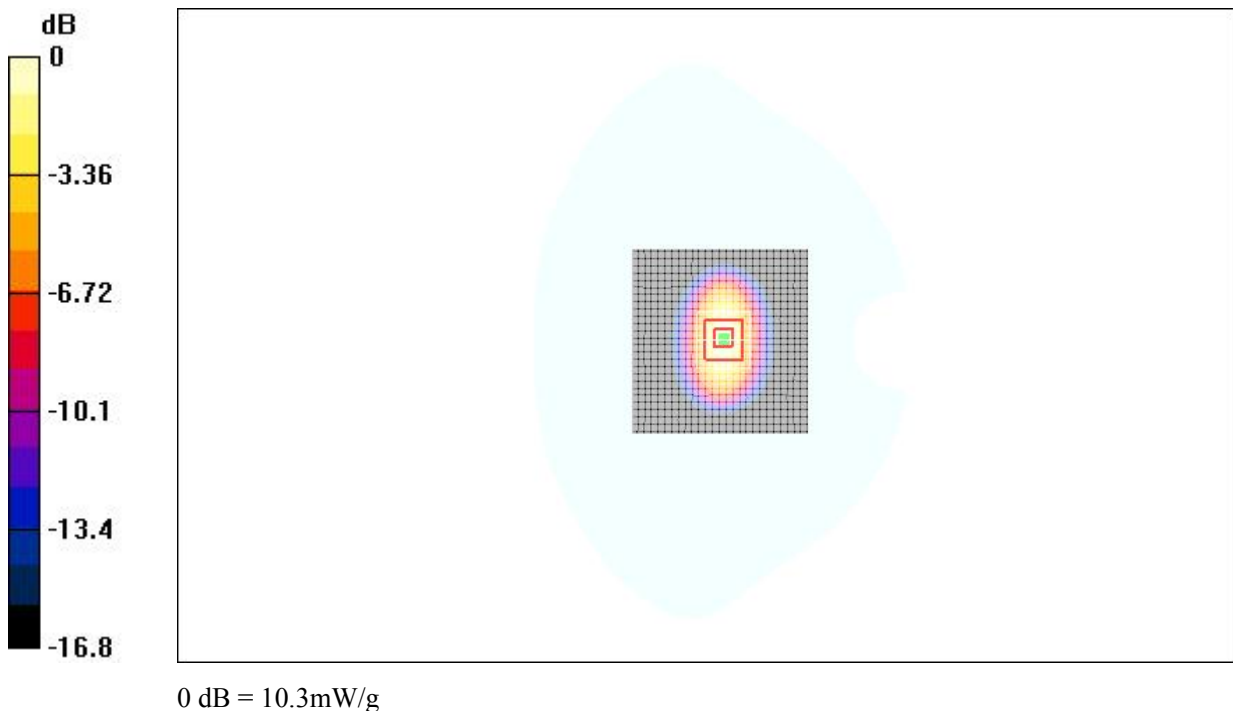
**System Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  
 $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $89.7 \text{ V/m}$ ; Power Drift =  $-0.065 \text{ dB}$

Peak SAR (extrapolated) =  $14.5 \text{ W/kg}$

**SAR(1 g) =  $9.78 \text{ mW/g}$ ; SAR(10 g) =  $4.88 \text{ mW/g}$**

Maximum value of SAR (measured) =  $10.3 \text{ mW/g}$



**Fig.53 validation 1900MHz 250mW**

## 1900MHz

Date/Time: 2011-5-28 07:28:52

Electronics: DAE4 Sn771

Medium: Body 1900 MHz

Medium parameters used:  $f = 1900 \text{ MHz}$ ;  $\sigma = 1.53 \text{ mho/m}$ ;  $\epsilon_r = 53.5$ ;  $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature:  $23.0^\circ\text{C}$       Liquid Temperature:  $22.5^\circ\text{C}$

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

Probe: ES3DV3 - SN3149 ConvF(4.68, 4.68, 4.68)

**System Validation/Area Scan (101x101x1):** Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$   
Maximum value of SAR (interpolated) =  $11.3 \text{ mW/g}$

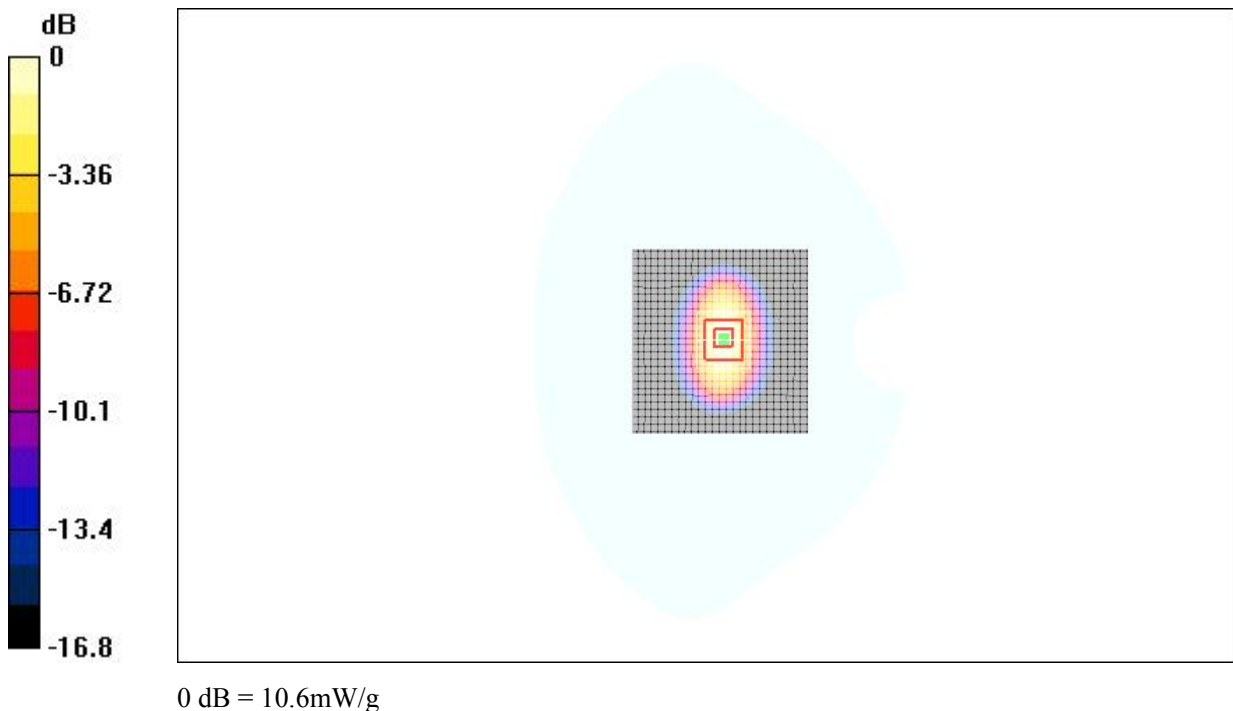
**System Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  
 $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $90.8 \text{ V/m}$ ; Power Drift =  $0.053 \text{ dB}$

Peak SAR (extrapolated) =  $15.9 \text{ W/kg}$

**SAR(1 g) =  $10.2 \text{ mW/g}$ ; SAR(10 g) =  $5.25 \text{ mW/g}$**

Maximum value of SAR (measured) =  $10.6 \text{ mW/g}$



**Fig.54 validation 1900MHz 250mW**



## 2450MHz

Date/Time: 2011-5-26 10:42:18

Electronics: DAE4 Sn771

Medium: Head 2450

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.82$  mho/m;  $\epsilon_r = 39.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature: 23.0°C      Liquid Temperature: 22.5°C

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

Probe: EX3DV4 - SN3617 ConvF(7.19, 7.19, 7.19)

**System Validation/Area Scan (101x101x1):** Measurement grid: dx=10mm, dy=10mm  
Maximum value of SAR (interpolated) = 13.9 mW/g

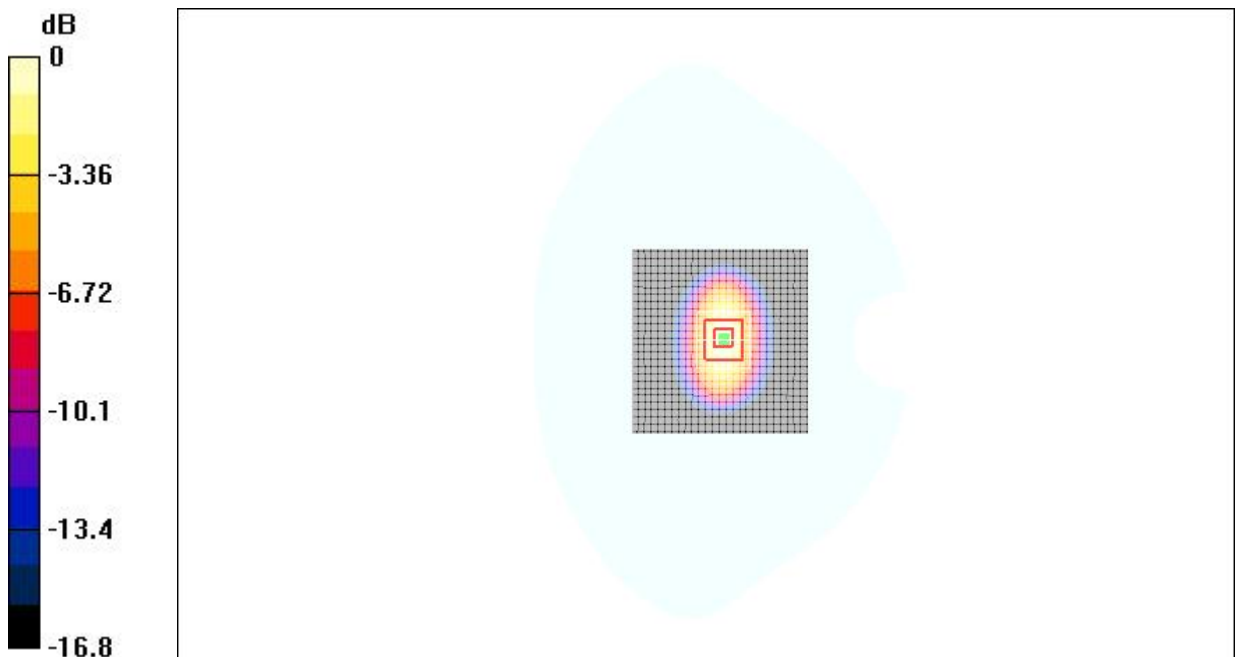
**System Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 86.0 V/m; Power Drift = -0.091 dB

Peak SAR (extrapolated) = 18.4 W/kg

**SAR(1 g) = 12.8 mW/g; SAR(10 g) = 5.93 mW/g**

Maximum value of SAR (measured) = 13.7 mW/g



0 dB = 13.7mW/g

**Fig.55 validation 2450MHz 250mW**

## 2450MHz

Date/Time: 2011-5-26 07:32:46

Electronics: DAE4 Sn771

Medium: Body 2450

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 52.0$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature: 23.0oC      Liquid Temperature: 22.5°C

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

Probe: EX3DV4 - SN3617 ConvF(6.88, 6.88, 6.88)

**System Validation/Area Scan (101x101x1):** Measurement grid: dx=10mm, dy=10mm  
Maximum value of SAR (interpolated) = 15.6 mW/g

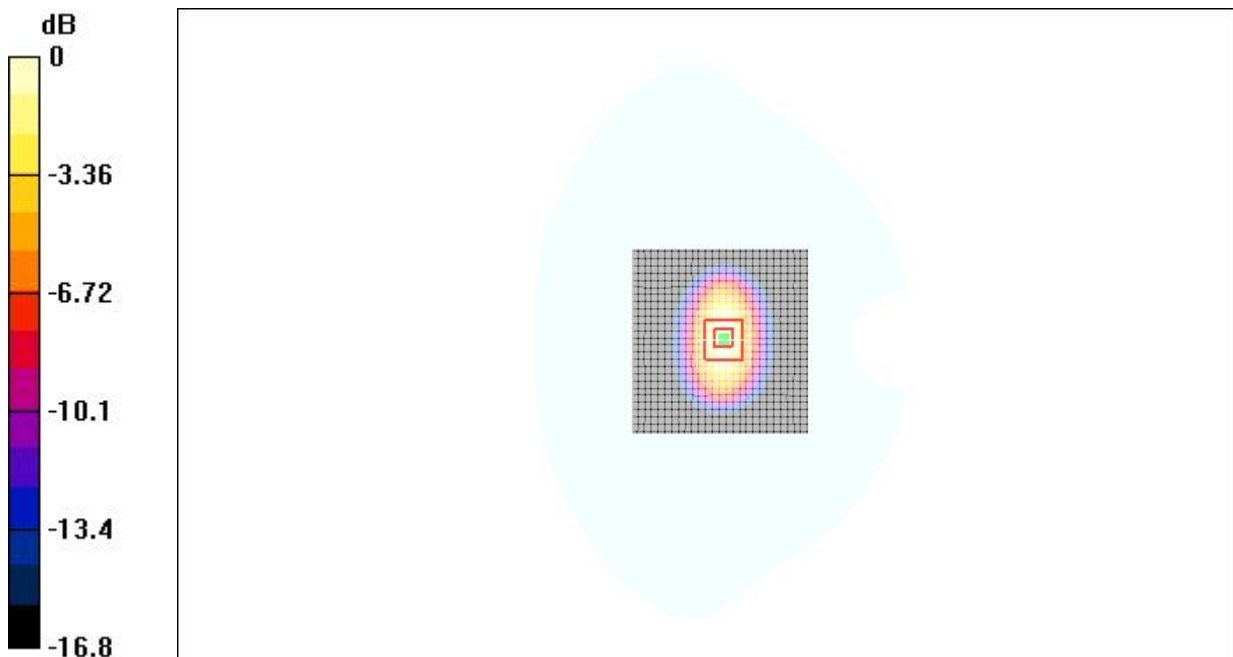
**System Validation/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 81.3 V/m; Power Drift = 0.062 dB

Peak SAR (extrapolated) = 24.0 W/kg

**SAR(1 g) = 12.8 mW/g; SAR(10 g) = 5.84 mW/g**

Maximum value of SAR (measured) = 14.4 mW/g



0 dB = 14.4mW/g

**Fig.56 validation 2450MHz 250mW**

## ANNEX E PROBE CALIBRATION CERTIFICATE

**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 **TMC China**

Certificate No: **ES3DV3-3149\_Sep10**

### CALIBRATION CERTIFICATE


Object	<b>ES3DV3-SN: 3149</b>
Calibration procedure(s)	<b>QA CAL-01.v6 Calibration procedure for dosimetric E-field probes</b>
Calibration date:	<b>September 25, 2010</b>
Condition of the calibrated item	<b>In Tolerance</b>

This calibration certify 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 at an environment temperature (22±3)°C and humidity<70%

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID#	Cal Data (Calibrated by, Certification NO.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-May-10 (METAS, NO. 251-00388)	May-11
Power sensor E4412A	MY41495277	5-May-10 (METAS, NO. 251-00388)	May-11
Reference 3 dB Attenuator	SN:S5054 (3c)	10-Aug-10 (METAS, NO. 251-00403)	Aug-11
Reference 20 dB Attenuator	SN:S5086 (20b)	3-May-10 (METAS, NO. 251-00389)	May-11
Reference 30 dB Attenuator	SN:S5129 (30b)	10-Aug-10 (METAS, NO. 251-00404)	Aug-11
DAE4	SN:617	10-Jun-10 (SPEAG, NO.DAE4-907_Jun10)	Jun-11
Reference Probe ES3DV2	SN: 3013	12-Jan-10 (SPEAG, NO. ES3-3013_Jan10)	Jan-11

Secondary Standards	ID#	Check Data (in house)	Scheduled Calibration
RF generator HP8648C	US3642U01700	4-Aug-99(SPEAG, in house check Oct-09)	In house check: Oct-10
Network Analyzer HP 8753E	US37390585	18-Oct-01(SPEAG, in house check Nov-09)	In house check: Nov-10

Name	Function	Signature
Calibrated by: Katja Pokovic	Technical Manager	

Approved by: Niels Kuster	Quality Manager	
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Issued: **September 25, 2010**

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

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



**S** Schweizerischer Kalibrierdienst  
**S** Service suisse d'étalonnage  
**C** 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**

**Glossary:**

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
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 (no uncertainty required). DCP does not depend on frequency nor media.
- **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.

ES3DV3 SN: 3149

September 25, 2010

# Probe ES3DV3

**SN: 3149**

Manufactured: June 12, 2007

Calibrated: September 25, 2010

Calibrated for DASY4 System

ES3DV3 SN: 3149

September 25, 2010

**DASY – Parameters of Probe: ES3DV3 SN:3149**

Sensitivity in Free Space<sup>A</sup>

Diode Compression<sup>B</sup>

NormX	1.14±10.1%	$\mu V/(V/m)^2$	DCP X	94mV
NormY	1.23±10.1%	$\mu V/(V/m)^2$	DCP Y	95mV
NormZ	1.29±10.1%	$\mu V/(V/m)^2$	DCP Z	91mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8

Boundary Effect

TSL                    900MHz      Typical SAR gradient: 5% per mm

Sensor Center to Phantom Surface Distance		3.0 mm	4.0 mm
SARbe[%]	Without Correction Algorithm	3.8	1.6
SARbe[%]	With Correction Algorithm	0.8	0.7

TSL                    1810MHz      Typical SAR gradient: 10% per mm

Sensor Center to Phantom Surface Distance		3.0 mm	4.0 mm
SARbe[%]	Without Correction Algorithm	6.8	3.6
SARbe[%]	With Correction Algorithm	0.4	0.2

Sensor Offset

Probe Tip to Sensor Center                    2.0 mm

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%.

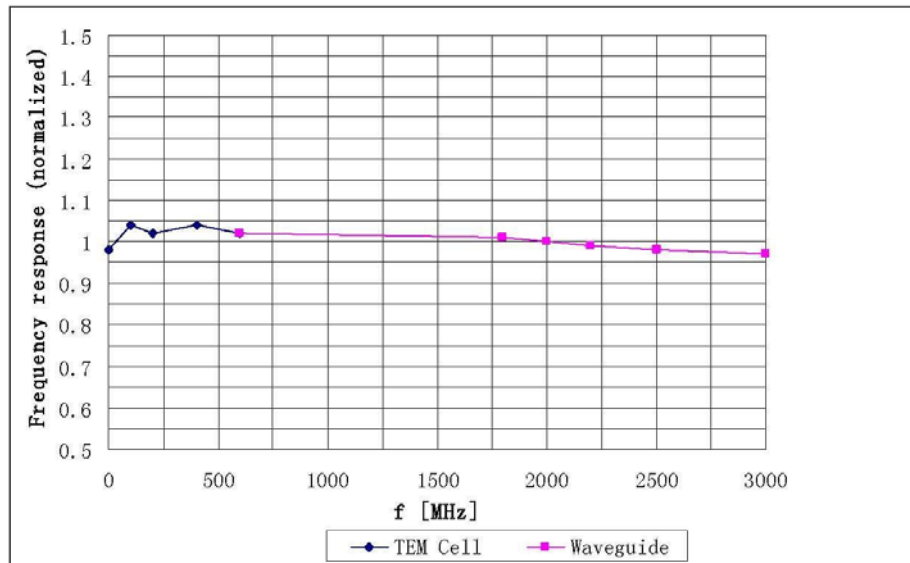
<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the  $E^2$ -field uncertainty inside TSL (see Page 8).

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

ES3DV3 SN: 3149

September 25, 2010

## Frequency Response of E-Field

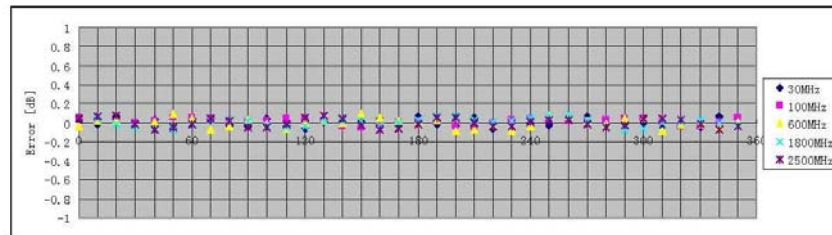
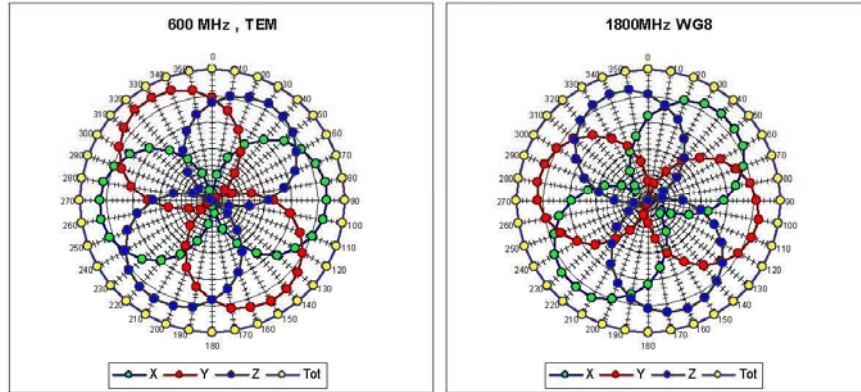


Uncertainty of Frequency Response of E-field:  $\pm 5.0\%$  ( $k=2$ )

ES3DV3 SN: 3149

September 25, 2010

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



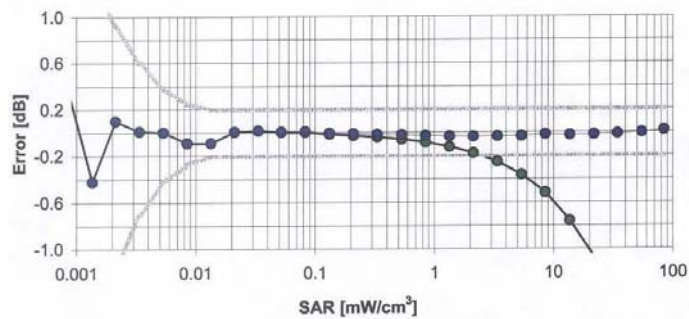
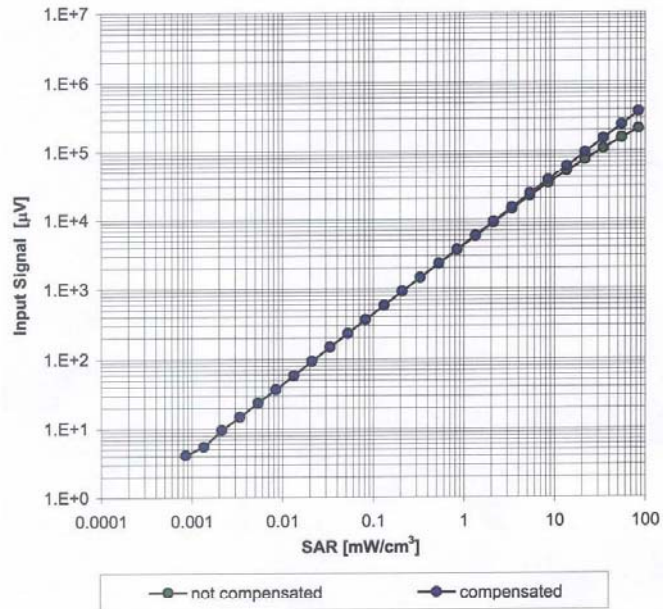
Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)



ES3DV3 SN: 3149

September 25, 2010

### Dynamic Range f(SAR<sub>head</sub>) (Waveguide: WG8, f = 1800 MHz)

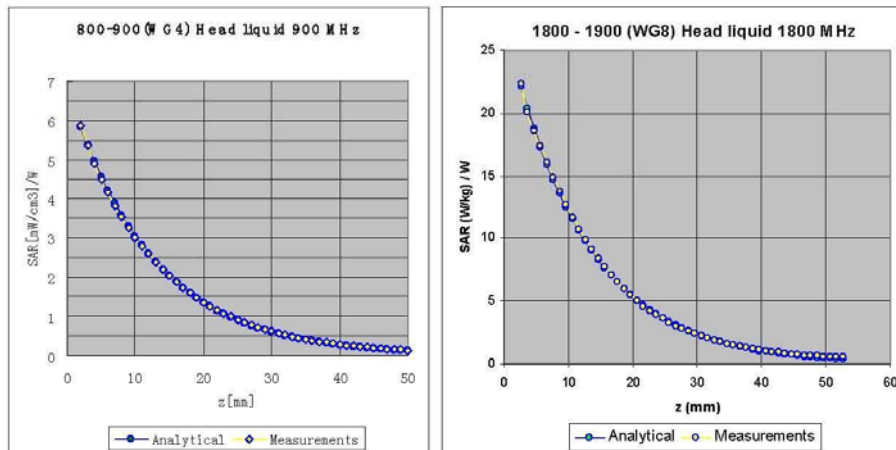


Uncertainty of Linearity Assessment:  $\pm 0.5\%$  (k=2)

ES3DV3 SN: 3149

September 25, 2010

## Conversion Factor Assessment



f[MHz]	Validity[MHz] <sup>C</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
850	±50 / ±100	Head	41.5±5%	0.90±5%	0.91	1.13	6.56	±11.0% (k=2)
900	±50 / ±100	Head	41.5±5%	0.97±5%	0.83	1.26	6.34	±11.0% (k=2)
1800	±50 / ±100	Head	40.0±5%	1.40±5%	0.69	1.47	5.18	±11.0% (k=2)
1900	±50 / ±100	Head	40.0±5%	1.40±5%	0.72	1.38	5.03	±11.0% (k=2)
2100	±50 / ±100	Head	39.8±5%	1.49±5%	0.66	1.34	4.58	±11.0% (k=2)
850	±50 / ±100	Body	55.2±5%	0.97±5%	0.76	1.26	6.22	±11.0% (k=2)
900	±50 / ±100	Body	55.0±5%	1.05±5%	0.99	1.06	6.02	±11.0% (k=2)
1800	±50 / ±100	Body	53.3±5%	1.52±5%	0.75	1.34	4.97	±11.0% (k=2)
1900	±50 / ±100	Body	53.3±5%	1.52±5%	0.62	1.33	4.68	±11.0% (k=2)
2100	±50 / ±100	Body	53.5±5%	1.57±5%	0.68	1.34	4.35	±11.0% (k=2)

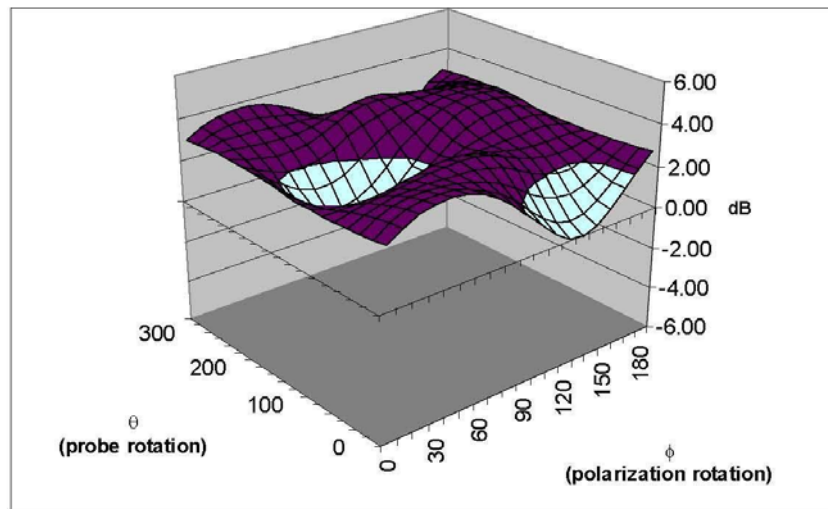
<sup>C</sup> The validity of ±100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

ES3DV3 SN: 3149

September 25, 2010

## Deviation from Isotropy

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



Uncertainty of Spherical Isotropy Assessment:  $\pm 2.5\%$  ( $k=2$ )

**Calibration Laboratory of  
Schmid & Partner  
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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 **TMC China**

Certificate No: **EX3DV4-3617\_Jul10**

**CALIBRATION CERTIFICATE**

Object	<b>EX3DV4-SN: 3617</b>
Calibration procedure(s)	<b>QA CAL-01.v6 Calibration procedure for dosimetric E-field probes</b>
Calibration date:	<b>July 9, 2010</b>
Condition of the calibrated item	<b>In Tolerance</b>

This calibration certify 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 at an environment temperature (22±3)°C and humidity<70%

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID#	Cal Data (Calibrated by, Certification NO.)	Scheduled Calibration
Power meter E4419B	GB41293874	6-May-10 (METAS, NO. 251-00388)	May-11
Power sensor E4412A	MY41495277	6-May-10 (METAS, NO. 251-00388)	May-11
Reference 3 dB Attenuator	SN:S5054 (3c)	12-Aug-09 (METAS, NO. 251-00403)	Aug-10
Reference 20 dB Attenuator	SN:S5086 (20b)	4-May-10 (METAS, NO. 251-00389)	May-11
Reference 30 dB Attenuator	SN:S5129 (30b)	12-Aug-09 (METAS, NO. 251-00404)	Aug-10
DAE4	SN:617	11-Jun-10 (SPEAG, NO.DAE4-907_Jun10)	Jun-11
Reference Probe ES3DV2	SN: 3013	13-Jan-10 (SPEAG, NO. ES3-3013_Jan10)	Jan-11

Secondary Standards	ID#	Check Data (in house)	Scheduled Calibration
RF generator HP8648C	US3642U01700	4-Aug-99(SPEAG, in house check Oct-09)	In house check: Oct-10
Network Analyzer HP 8753E	US37390585	18-Oct-01(SPEAG, in house check Nov-09)	In house check: Nov-10

Name	Function	Signature
Calibrated by: <b>Katja Pokovic</b>	<b>Technical Manager</b>	
Approved by: <b>Niels Kuster</b>	<b>Quality Manager</b>	

Issued: **July 9, 2010**

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

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



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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

**Glossary:**

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
Polarization $\phi$	$\phi$ 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<sup>2</sup>-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 (no uncertainty required). DCP does not depend on frequency nor media.
- **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.

EX3DV4 SN: 3617

July 9, 2010

# Probe EX3DV4

**SN: 3617**

Manufactured: May 3, 2007

Calibrated: July 9, 2010

Calibrated for DASY4 System

EX3DV4 SN: 3617

July 9, 2010

**DASY – Parameters of Probe: EX3DV4 SN:3617**

Sensitivity in Free Space<sup>A</sup>

Diode Compression<sup>B</sup>

NormX	0.420±10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	89mV
NormY	0.440±10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	88mV
NormZ	0.310±10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	91mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)  
Please see Page 8

Boundary Effect

TSL            2450MHz    Typical SAR gradient: 11% per mm

Sensor Center to Phantom Surface Distance		2.0 mm	3.0 mm
SARbe[%]	Without Correction Algorithm	3.7	1.8
SARbe[%]	With Correction Algorithm	0.1	0.0

TSL            5200MHz    Typical SAR gradient: 25% per mm

Sensor Center to Phantom Surface Distance		2.0 mm	3.0 mm
SARbe[%]	Without Correction Algorithm	10.1	3.7
SARbe[%]	With Correction Algorithm	0.2	0.1

Sensor Offset

Probe Tip to Sensor Center                            1.0 mm

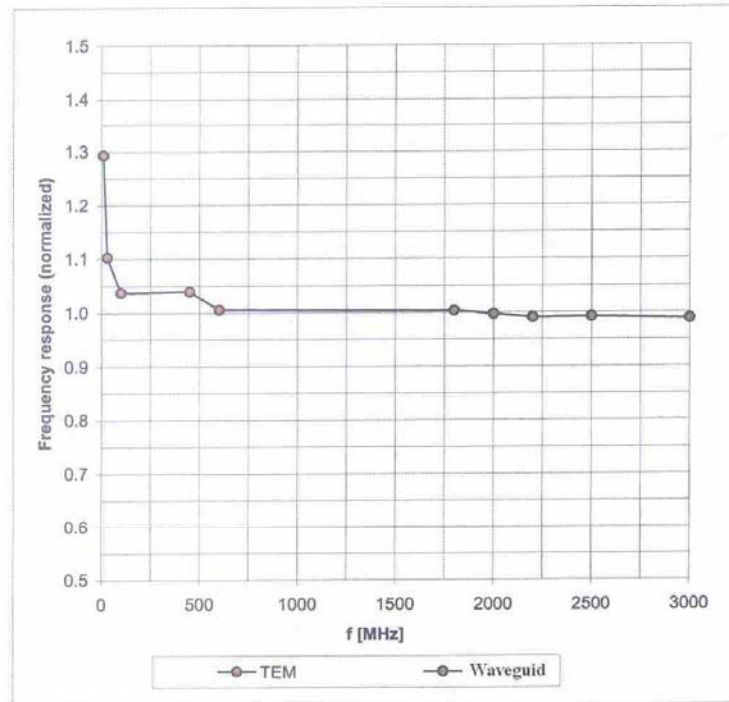
The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution Corresponds to a coverage probability of approximately 95%.

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the  $E^2$ -field uncertainty inside TSL (see Page 8).  
<sup>B</sup> Numerical linearization parameter: uncertainty not required.

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July 9, 2010

### Frequency Response of E-Field



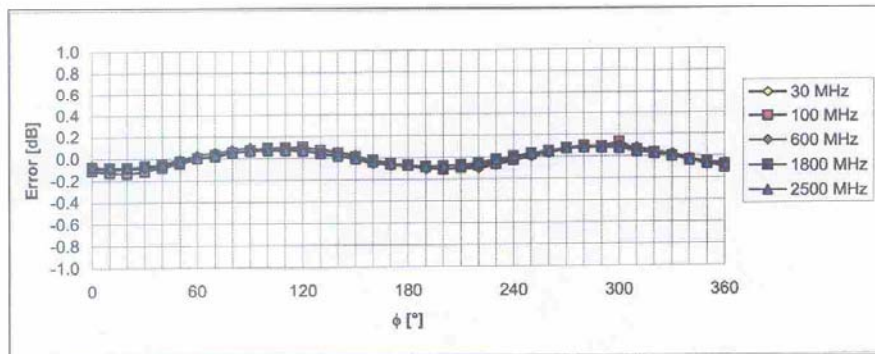
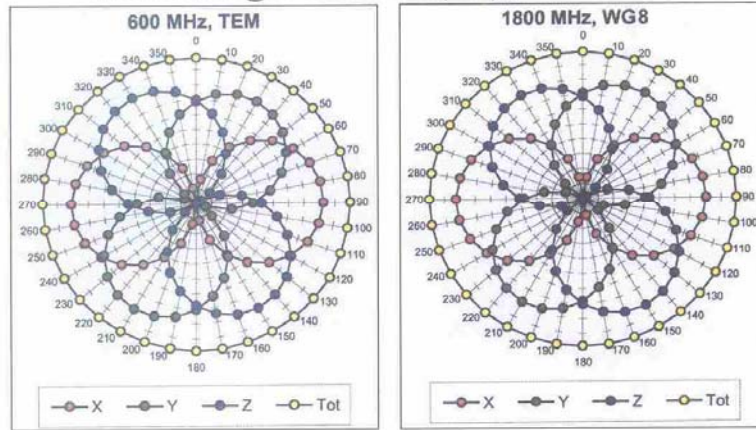
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)



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July 9, 2010

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

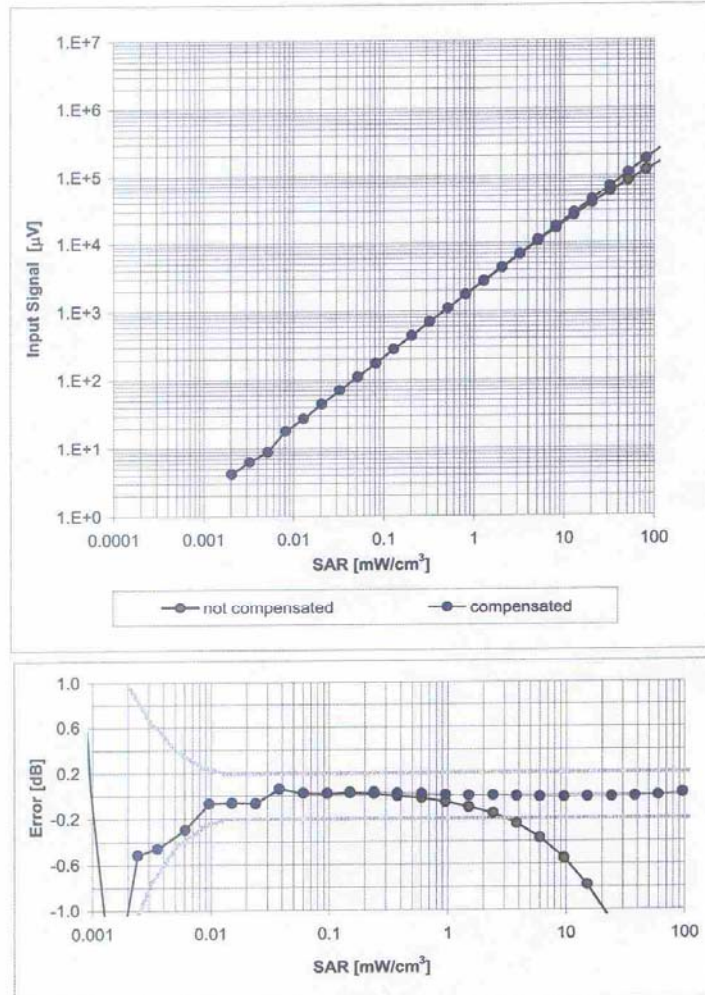


Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

EX3DV4 SN: 3617

July 9, 2010

### Dynamic Range $f(\text{SAR}_{\text{head}})$ (Waveguide: WG8, $f = 1800 \text{ MHz}$ )

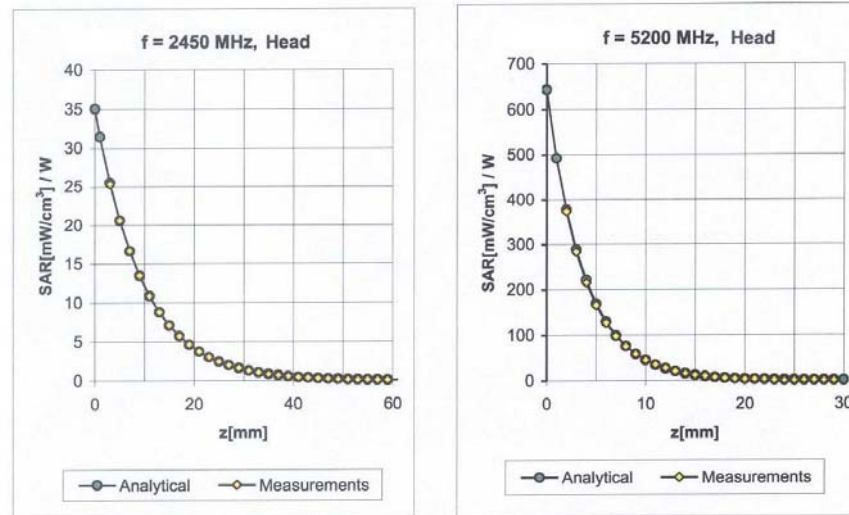


Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )

EX3DV4 SN: 3617

July 9, 2010

## Conversion Factor Assessment



f [MHz]	Validity [MHz] <sup>C</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
2300	± 50 / ± 100	Head	39.5 ± 5%	1.67 ± 5%	0.33	1.02	7.23	± 11.8% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.33	1.00	7.19	± 11.8% (k=2)
2600	± 50 / ± 100	Head	39.0 ± 5%	1.96 ± 5%	0.36	1.21	7.16	± 11.8% (k=2)
3500	± 50 / ± 100	Head	37.9 ± 5%	2.91 ± 5%	0.34	1.35	6.48	± 11.8% (k=2)
5200	± 50 / ± 100	Head	36.0 ± 5%	4.66 ± 5%	0.35	1.60	5.33	± 13.1% (k=2)
5800	± 50 / ± 100	Head	35.3 ± 5%	5.27 ± 5%	0.35	1.60	4.69	± 13.1% (k=2)
2300	± 50 / ± 100	Body	52.8 ± 5%	1.85 ± 5%	0.30	1.01	6.95	± 11.8% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.36	1.00	6.88	± 11.8% (k=2)
2600	± 50 / ± 100	Body	52.5 ± 5%	2.16 ± 5%	0.36	1.05	6.84	± 11.8% (k=2)
3500	± 50 / ± 100	Body	51.3 ± 5%	3.30 ± 5%	0.33	1.40	5.02	± 11.8% (k=2)
5200	± 50 / ± 100	Body	49.0 ± 5%	5.30 ± 5%	0.35	1.70	4.64	± 13.1% (k=2)
5800	± 50 / ± 100	Body	48.2 ± 5%	6.00 ± 5%	0.30	1.70	4.53	± 13.1% (k=2)

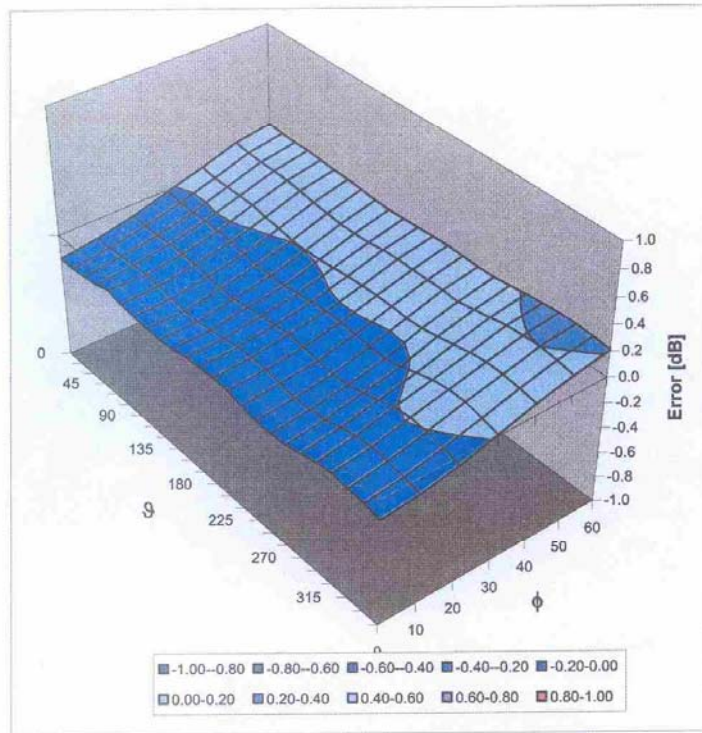
<sup>C</sup> The validity of ±100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

EX3DV4 SN: 3617

July 9, 2010

### Deviation from Isotropy

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





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


## ANNEX F DIPOLE CALIBRATION CERTIFICATE

### 835 MHz Dipole Calibration Certificate

工业和信息化部通信计量中心  
Telecommunication Metrology Center of MIIT







校准  
CNAS L0442

Client **TMC** Certificate No: **D835V2-443\_Feb10**

**CALIBRATION CERTIFICATE**

Object: **D835V2 - SN: 443**

Calibration Procedure(s): **TMC-XZ-01-027  
Calibration procedure for dipole validation kits**

Calibration date: **February 26, 2010**

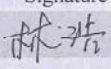
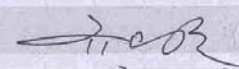
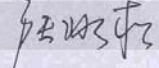
Condition of the calibrated item: **In Tolerance**

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(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	101253	04-Sep-09 (TMC, No.JZ09-248)	Jun-10
Power sensor NRV-Z5	100333	04-Sep-09 (TMC, No. JZ09-248)	Jun-10
Reference Probe ES3DV3	SN 3149	25-Sep-09(SPEAG, No.ES3-3149_Sep09)	Sep-10
DAE4	SN 771	19-Nov-09(SPEAG, No.DAE4-771_Nov09)	Nov-10
RF generator E4438C	MY45092879	18-Jun-09(TMC, No.JZ09-302)	Jun-10
Network Analyzer 8753E	US38433212	29-Aug-09(TMC, No.JZ09-056)	Aug-10

	Name	Function	Signature
Calibrated by:	Lin Hao	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: February 26, 2010

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

Certificate No: D835V2-443\_Feb10

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**Glossary:**

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
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 300MHz to 3GHz)", 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) DASY 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	V5.0
Extrapolation	Advanced Extrapolation	
Phantom	2mm Oval Phantom ELI4	
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	41.6 ± 6 %	0.92mho/m ± 6 %
Head TSL temperature during test	(21.7 ± 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	2.38 mW / g
SAR normalized	normalized to 1W	9.52 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>9.41 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	1.54 mW / g
SAR normalized	normalized to 1W	6.16 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>6.12 mW / g ± 16.5 % (k=2)</b>

<sup>1</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

### 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	54.5 ± 6%	0.97mho/m ± 6 %
Body TSL temperature during test	(21.9 ± 0.2) °C	----	----

### SAR result with Body TSL

SAR averaged over 1 $cm^3$ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.41 mW / g
SAR normalized	normalized to 1W	9.64 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	<b>9.57 mW / g ± 17.0 % (k=2)</b>

SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.57 mW / g
SAR normalized	normalized to 1W	6.28 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	<b>6.24 mW / g ± 16.5 % (k=2)</b>

<sup>2</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"



## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.7Ω - 3.7 jΩ
Return Loss	- 25.9dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.4Ω - 5.1 jΩ
Return Loss	-25.6dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.387 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	September 3, 2001

工业和信息化部通信计量中心  
Telecommunication Metrology Center of MIIT



**DASY5 Validation Report for Head TSL**

Date/Time: 2010-2-26 14:31:40

Test Laboratory: TMC, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: SN: 443

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

Medium: Head 835MHz

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.92 \text{ mho/m}$ ;  $\epsilon_r = 41.6$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(6.56, 6.56, 6.56); Calibrated: 25.09.09
- Electronics: DAE4 Sn771; Calibration: 19.11.09
- Phantom: 2mm Oval Phantom ELI4; Type: QDOVA001BB
- Measurement SW: DASY5, V5.0 Build 119.9; Postprocessing SW: SEMCAD, V13.2 Build 87

Pin=250mW; d=15mm/Zoom Scan (7x7x7)/Cube 0:

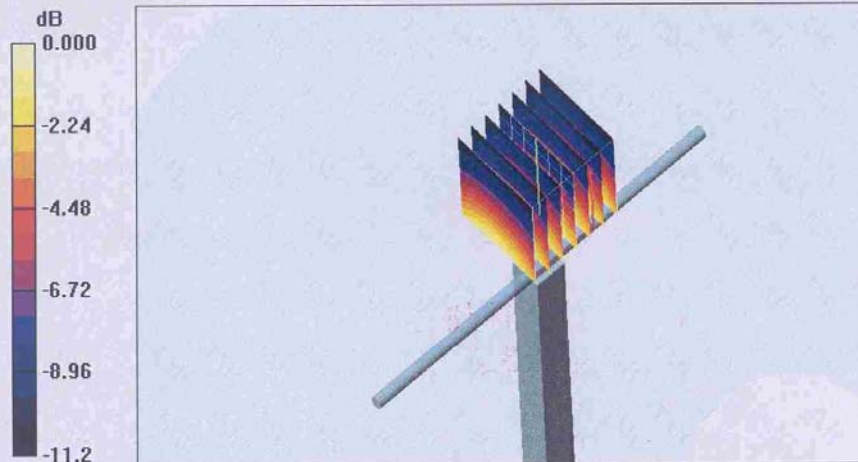
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.8 V/m; Power Drift = -0.037 dB

Peak SAR (extrapolated) = 3.11 W/kg

SAR(1 g) = 2.38 mW/g; SAR(10 g) = 1.54 mW/g

Maximum value of SAR (measured) = 2.71 mW/g



0 dB = 2.71mW/g

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Impedance Measurement Plot for Head TSL

