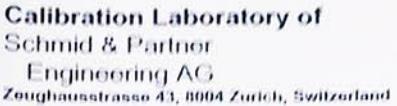


8 Calibration Certificate

8.1 Probe Calibration Certificate

   <div style="display: flex; justify-content: space-around; margin-top: 5px;"> S Schweizerischer Kalibrierdienst C Service suisse d'étalonnage </div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> S Servizio svizzero di taratura S Swiss Calibration Service </div>																																																											
<small>Accredited by the Swiss Accreditation Service (SCS)</small> <small>The Swiss Accreditation Service is one of the signatories to the EA</small> <small>Multilateral Agreement for the recognition of calibration certificates</small>																																																											
Client	Accreditation No.: SCS 0108																																																										
Client	Certificate No: EX3-3842_Aug15																																																										
CALIBRATION CERTIFICATE																																																											
<p>Object EX3DV4 - SN:3842</p> <p>Calibration procedure(s) QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes</p> <p>Calibration date: August 26, 2015</p> <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 < 70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th>Primary Standards</th> <th>ID</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter E4419B</td> <td>GB41293874</td> <td>01-Apr-15 (No. 217-02128)</td> <td>Mar-16</td> </tr> <tr> <td>Power sensor E4412A</td> <td>MY441498087</td> <td>01-Apr-15 (No. 217-02128)</td> <td>Mar-16</td> </tr> <tr> <td>Reference 3 dB Attenuator</td> <td>SN: 55054 (3c)</td> <td>01-Apr-15 (No. 217-02129)</td> <td>Mar-16</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>SN: 55277 (20c)</td> <td>01-Apr-15 (No. 217-02132)</td> <td>Mar-16</td> </tr> <tr> <td>Reference 30 dB Attenuator</td> <td>SN: 55129 (30b)</td> <td>01-Apr-15 (No. 217-02133)</td> <td>Mar-16</td> </tr> <tr> <td>Reference Probe ES3DV2</td> <td>SN: 3013</td> <td>30-Dec-14 (No. ES3-3013_Dec14)</td> <td>Dec-15</td> </tr> <tr> <td>DAE4</td> <td>SN: 660</td> <td>14-Jan-15 (No. DAE4-660_Jan15)</td> <td>Jan-16</td> </tr> <tr> <td>Secondary Standards</td> <td>ID</td> <td>Check Date (in house)</td> <td>Scheduled Check</td> </tr> <tr> <td>RF generator HP 8648C</td> <td>US3642U01700</td> <td>4-Aug-99 (in house check Apr-13)</td> <td>In house check: Apr-16</td> </tr> <tr> <td>Network Analyzer HP 8753E</td> <td>US37390585</td> <td>18-Oct-01 (in house check Oct-14)</td> <td>In house check: Oct-15</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <tr> <td style="width: 25%;">Calibrated by:</td> <td style="width: 25%;">Name</td> <td style="width: 25%;">Function</td> <td style="width: 25%;">Signature</td> </tr> <tr> <td></td> <td>Claudio Leubler</td> <td>Laboratory Technician</td> <td></td> </tr> <tr> <td>Approved by:</td> <td>Katja Pokovic</td> <td>Technical Manager</td> <td></td> </tr> </table> <p style="text-align: right; margin-top: 10px;">Issued: August 27, 2015</p> <p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p>				Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration	Power meter E4419B	GB41293874	01-Apr-15 (No. 217-02128)	Mar-16	Power sensor E4412A	MY441498087	01-Apr-15 (No. 217-02128)	Mar-16	Reference 3 dB Attenuator	SN: 55054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16	Reference 20 dB Attenuator	SN: 55277 (20c)	01-Apr-15 (No. 217-02132)	Mar-16	Reference 30 dB Attenuator	SN: 55129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16	Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15	DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16	Secondary Standards	ID	Check Date (in house)	Scheduled Check	RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16	Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15	Calibrated by:	Name	Function	Signature		Claudio Leubler	Laboratory Technician		Approved by:	Katja Pokovic	Technical Manager	
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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 0108**

Glossary:

TS	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization β	β rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\beta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- $NORM_{x,y,z}$: Assessed for E-field polarization $\beta = 0$ ($f < 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). $NORM_{x,y,z}$ are only intermediate values, i.e., the uncertainties of $NORM_{x,y,z}$ does not affect the E^2 -field uncertainty inside TSL (see below *ConvF*).
- $NORM(f)x,y,z = NORM_{x,y,z} * frequency\ response$ (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*.
- $DCPx,y,z$: 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.
- PAR : PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- $A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}$: $VR_{x,y,z}$: A, B, C, D 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 $NORM_{x,y,z} * ConvF$ 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 ± 50 MHz to ± 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.
- Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

EX3DV4 – SN:3842

August 26, 2015

Probe EX3DV4

SN:3842

Manufactured: October 25, 2011
Calibrated: August 26, 2015

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

EX3DV4- SN:3842

August 26, 2015

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3842

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^a	0.34	0.53	0.42	$\pm 10.1 \%$
DCP (mV) ^b	101.6	99.9	99.5	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^c (k=2)
0	CW	X	0.0	0.0	1.0	0.00	152.0	$\pm 3.0 \%$
		Y	0.0	0.0	1.0		143.5	
		Z	0.0	0.0	1.0		147.4	

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%.

^a The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

^b Numerical linearization parameter, uncertainty not required.

^c Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

EX3DV4 - SN:3842

August 26, 2015

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3842

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	9.45	9.45	9.45	0.34	0.93	± 12.0 %
835	41.5	0.90	9.04	9.04	9.04	0.18	1.60	± 12.0 %
900	41.5	0.97	8.92	8.92	8.92	0.22	1.45	± 12.0 %
1750	40.1	1.37	7.80	7.80	7.80	0.35	0.80	± 12.0 %
1900	40.0	1.40	7.54	7.54	7.54	0.29	0.80	± 12.0 %
2450	39.2	1.80	6.82	6.82	6.82	0.35	0.86	± 12.0 %
2600	39.0	1.96	6.74	6.74	6.74	0.37	0.92	± 12.0 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4- SN:3842

August 26, 2015

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3842

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
450	56.7	0.94	10.28	10.28	10.28	0.10	1.20	± 13.3 %
750	55.5	0.96	9.38	9.38	9.38	0.35	1.02	± 12.0 %
835	55.2	0.97	9.18	9.18	9.18	0.27	1.22	± 12.0 %
900	55.0	1.05	9.11	9.11	9.11	0.26	1.17	± 12.0 %
1750	53.4	1.49	7.46	7.46	7.46	0.35	0.80	± 12.0 %
1900	53.3	1.52	7.29	7.29	7.29	0.40	0.86	± 12.0 %
2450	52.7	1.95	6.87	6.87	6.87	0.34	0.80	± 12.0 %
2600	52.5	2.16	6.76	6.76	6.76	0.32	0.80	± 12.0 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

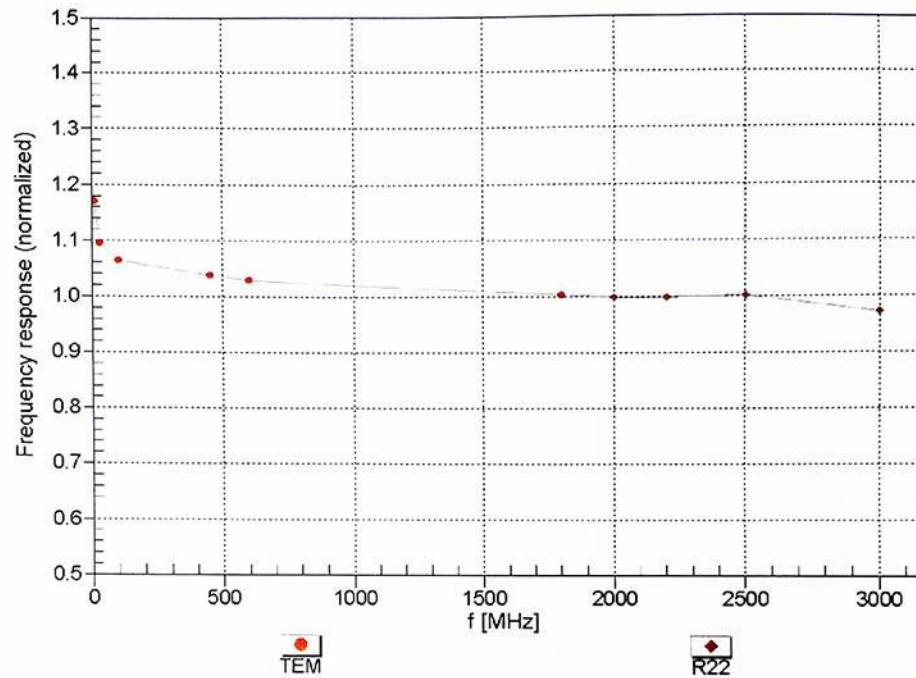
^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4- SN:3842

August 26, 2015

Frequency Response of E-Field

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



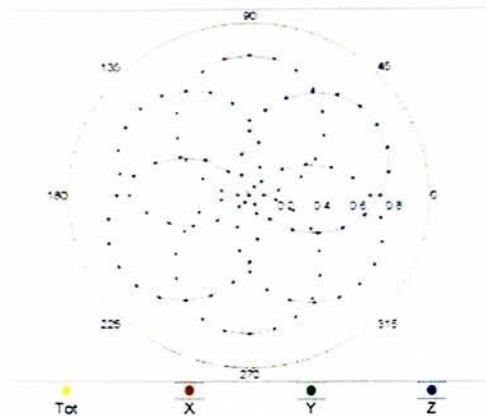
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

EX3DV4- SN 3842

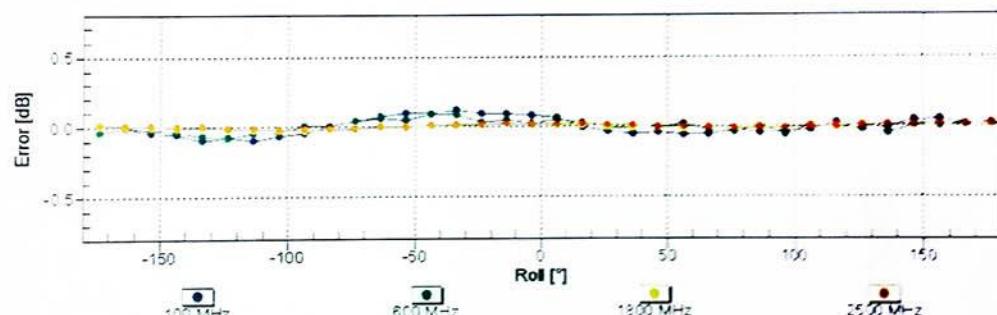
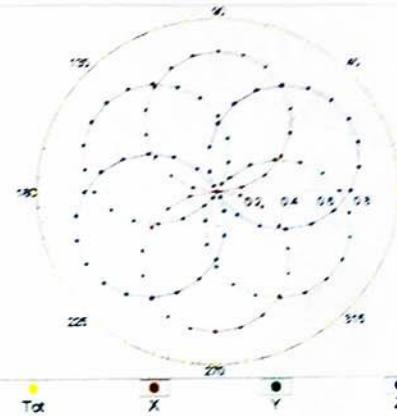
August 26, 2015

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

f=600 MHz, TEM



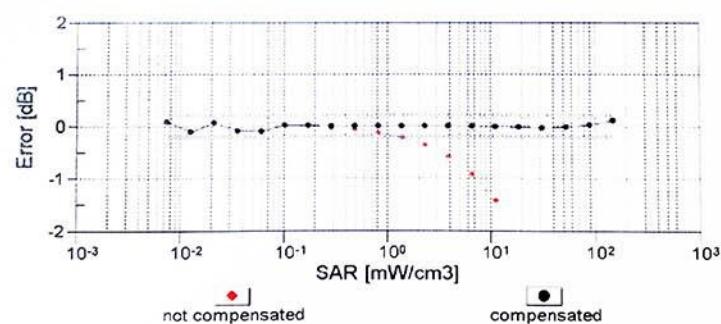
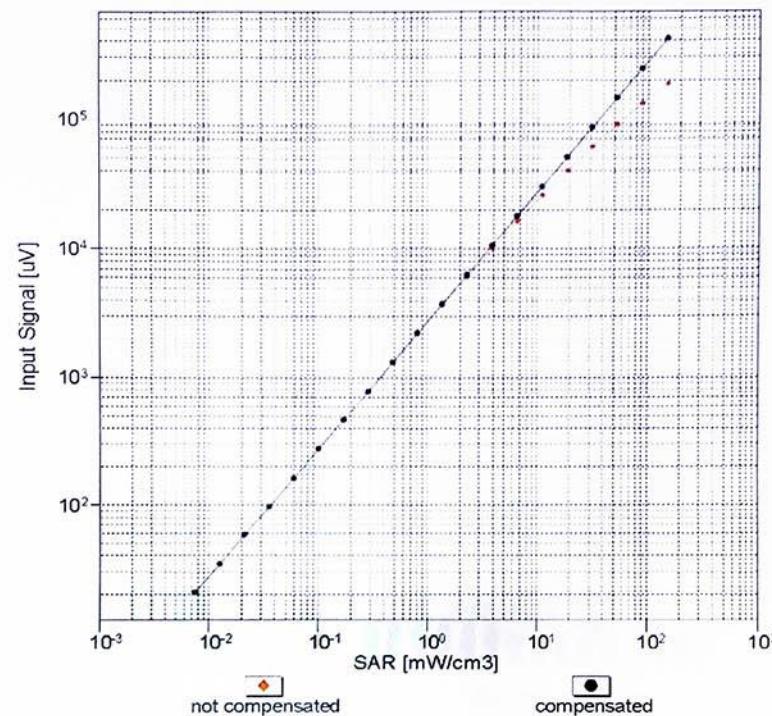
f=1800 MHz, R22

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

EX3DV4- SN:3842

August 26, 2015

Dynamic Range $f(\text{SAR}_{\text{head}})$
(TEM cell, $f_{\text{eval}} = 1900$ MHz)

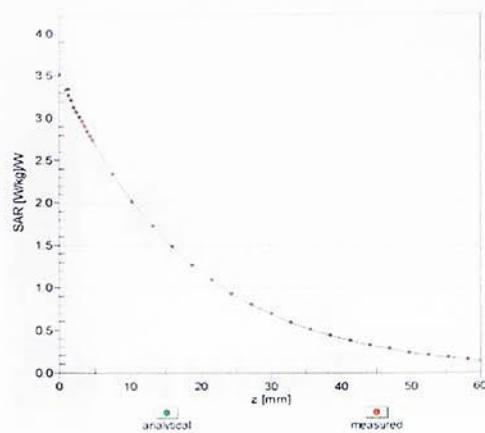
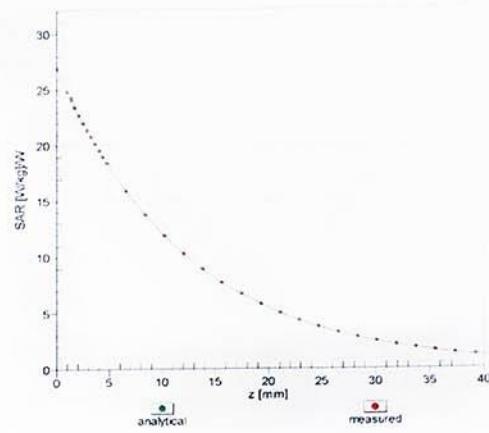


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

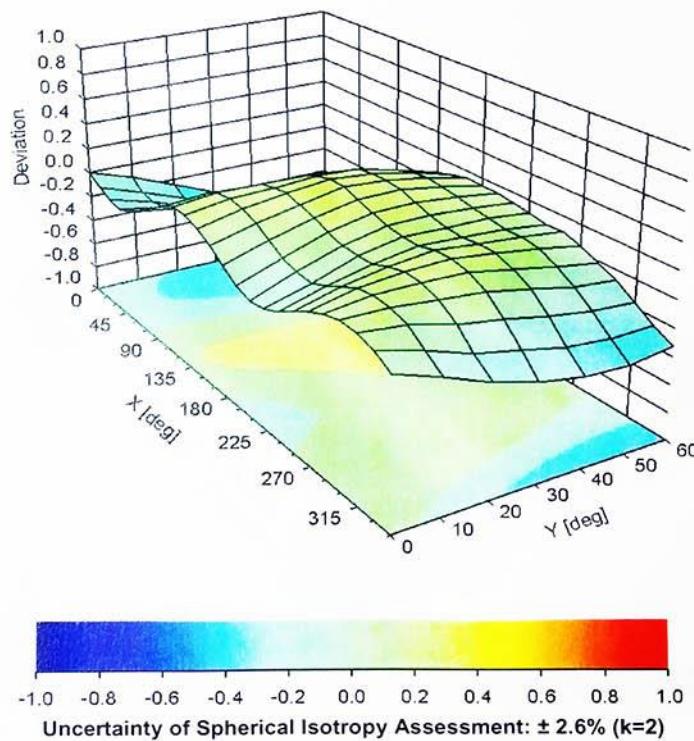
EX3DV4- SN:3842

August 26, 2015

Conversion Factor Assessment

 $f = 900 \text{ MHz, WGLS R9 (H_convF)}$  $f = 1750 \text{ MHz, WGLS R22 (H_convF)}$ 

Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$ 

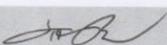
EX3DV4- SN:3842

August 26, 2015

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3842**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	66.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

8.2 D900V2 Dipole Calibration Certificate

 <p>In Collaboration with s p e a g CALIBRATION LABORATORY</p> <p>Add: No.52 Huayuanbei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: Info@emcite.com Http://www.emcite.com</p>		  <p>校准 CNAS L0442</p>	
Client	Sunway	Certificate No: J13-2-2185	
CALIBRATION CERTIFICATE			
Object	D900V2 - SN: 1d086		
Calibration Procedure(s)	TMC-OS-E-02-194 Calibration procedure for dipole validation kits		
Calibration date:	August 9, 2013		
<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<70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p>			
Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	11-Sep-12 (TMC, No.JZ12-443)	Sep-13
Power sensor NRV-Z5	100595	11-Sep-12 (TMC, No. JZ12-443)	Sep -13
Reference Probe EX3DV4	SN 3846	20- Dec-12 (SPEAG, No.EX3-3846_Dec12)	Dec-13
DAE4	SN 777	22-Feb-13 (SPEAG, DAE4-777_Feb13)	Feb -14
Signal Generator E4438C	MY49070393	13-Nov-12 (TMC, No.JZ12-394)	Nov-13
Network Analyzer E8362B	MY43021135	19-Oct-12 (TMC, No.JZ13-278)	Oct-13
Calibrated by:	Name	Function	Signature
	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Xiao Li	Deputy Director of the laboratory	
Issued: August 11, 2013			
<p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p>			
Certificate No: J13-2-2185		Page 1 of 8	



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E-mail: Info@emcite.com [Http://www.emcite.com](http://www.emcite.com)

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,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 300MHz to 3GHz)", February 2005
- c) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

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.

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%.



Add: No.52 Huayuanbei Road, Haidian District, Beijing, 100191, China
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 E-mail: Info@emcite.com
[Http://www.emcite.com](http://www.emcite.com)

Measurement Conditions

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

DASY Version	DASY52	52.8.7.1137
Extrapolation	Advanced Extrapolation	
Phantom	Twin Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	900 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	0.97 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.6 ± 6 %	0.98 mho/m ± 6 %
Head TSL temperature change during test	<0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.67 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	10.7 mW / g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.72 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.87 mW / g ± 20.4 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.0	1.05 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.2 ± 6 %	1.02 mho/m ± 6 %
Body TSL temperature change during test	<0.5 °C	---	---

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.63 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	10.7mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.71 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.94 mW /g ± 20.4 % (k=2)



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[Http://www.emcite.com](http://www.emcite.com)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.1Ω-8.85jΩ
Return Loss	-22.3dB

Antenna Parameters with Body TSL

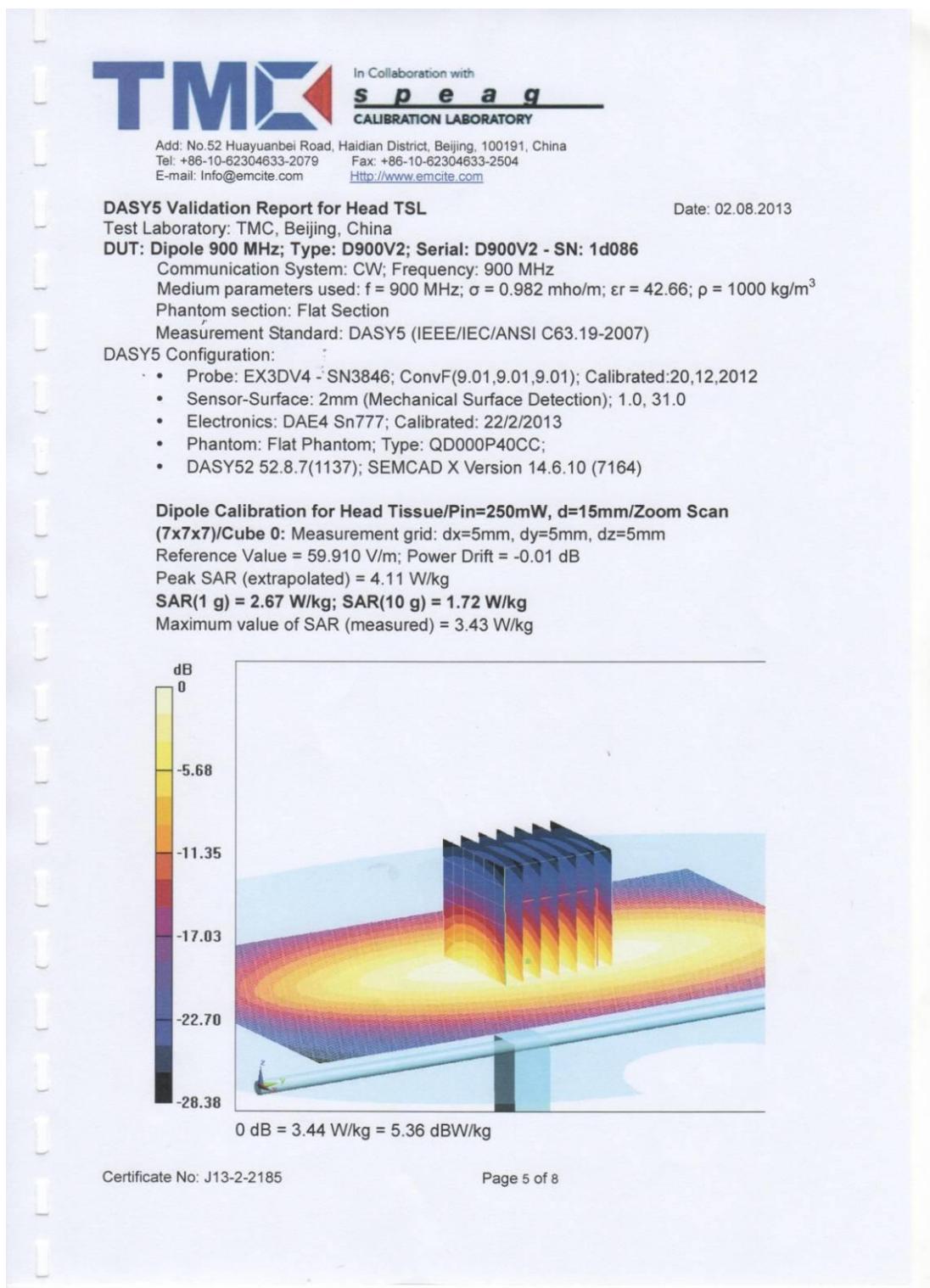
Impedance, transformed to feed point	42.1Ω+0.52jΩ
Return Loss	-21.3dB

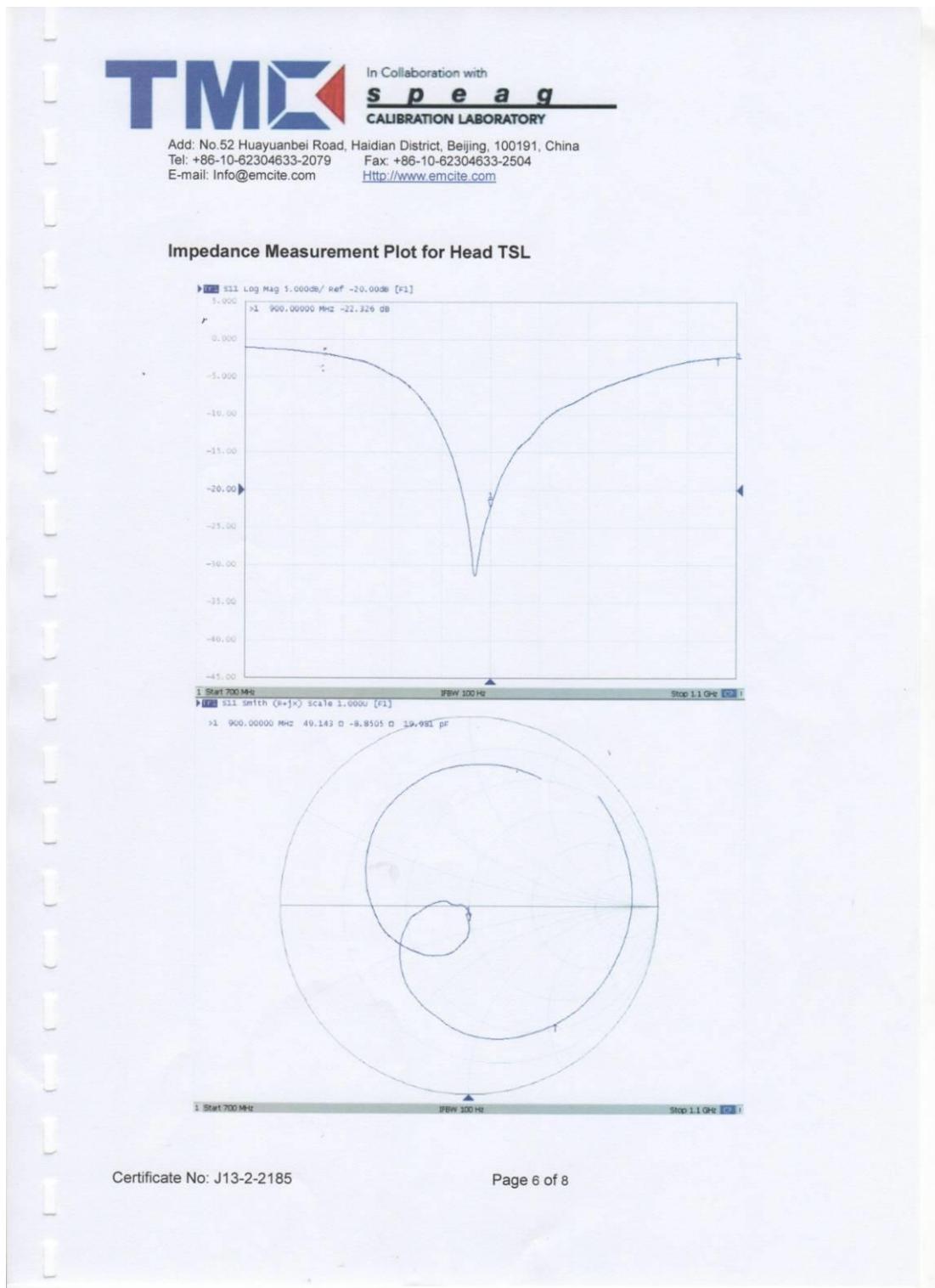
After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
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
-----------------	-------







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DASY5 Validation Report for Body TSL

Date: 02.08.2013

Test Laboratory: TMC, Beijing, China

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 1d086

Communication System: CW; Frequency: 900 MHz;

Medium parameters used: $f = 900$ MHz; $\sigma = 1.023$ mho/m; $\epsilon_r = 54.207$; $\rho = 1000$ kg/m³

Phantom section: ELI 4.0

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3846; ConvF(9.01,9.01,9.01); Calibrated: 20.12.2012
- Sensor-Surface: 2mm (Mechanical Surface Detection); 1.0, 31.0
- Electronics: DAE4 Sn777; Calibrated: 22/2/2013
- Phantom: ELI 4.0; Type: QDOVA001DB;
- DASY52 52.8.7(1137); SEMCAD X Version 14.6.10 (7164)

Dipole Calibration for Body Tissue/Pin=250mW, d=15mm/Zoom Scan

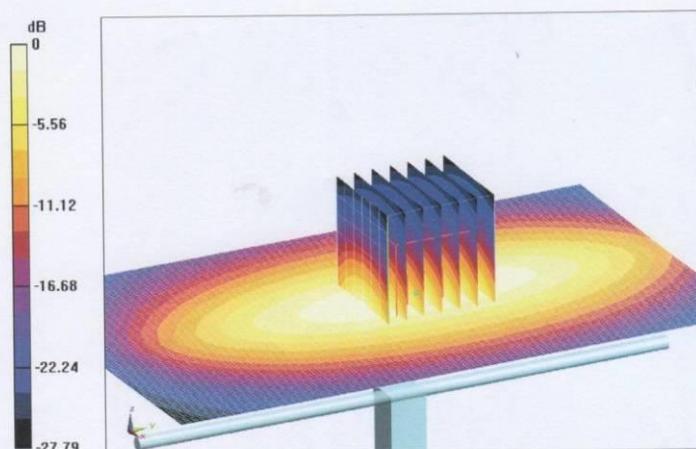
(7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.362 V/m; Power Drift = 0.05 dB

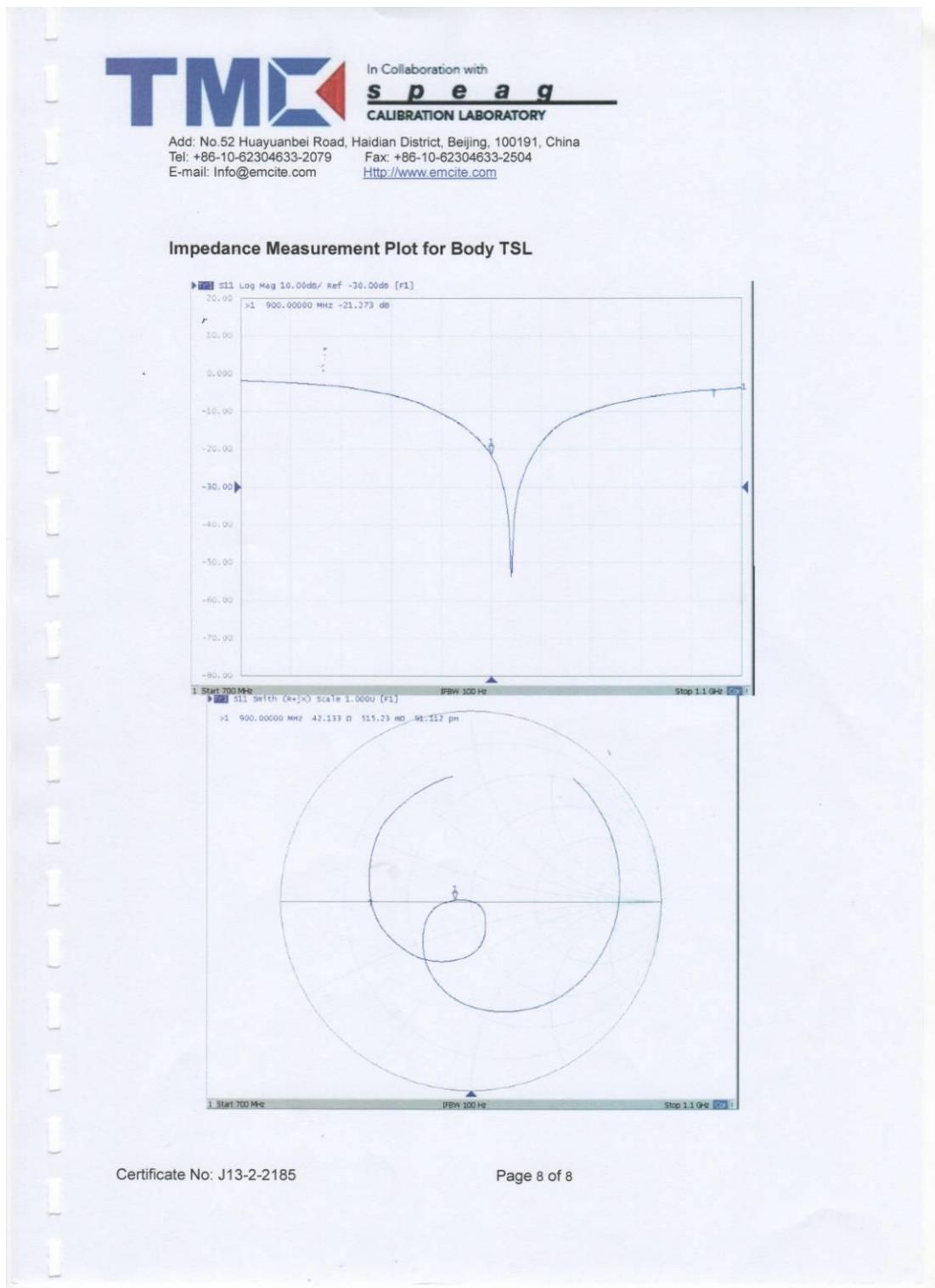
Peak SAR (extrapolated) = 3.90 W/kg

SAR(1 g) = 2.63 W/kg; SAR(10 g) = 1.71 W/kg

Maximum value of SAR (measured) = 3.33 W/kg



0 dB = 3.31 W/kg = 5.19 dBW/kg



Certificate No: J13-2-2185

Page 8 of 8

D900V2, serial no. 1d086 Extended Dipole Calibrations

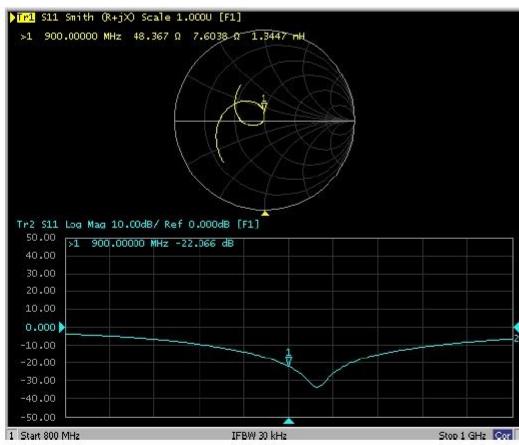
Referring to KDB 865664D01V01r03, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

D900V2, serial no. 1d086								
	900 Head				900 Body			
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)
2013-8-9	-22.3		49.2		-21.3		42.1	
2014-8-8	-22.21	0.41	49.12	-0.08	-21.1	0.94	42.25	-0.15
2015-8-4	-22.1	0.9	48.4	-0.8	-21.4	-0.5	43.1	1.0

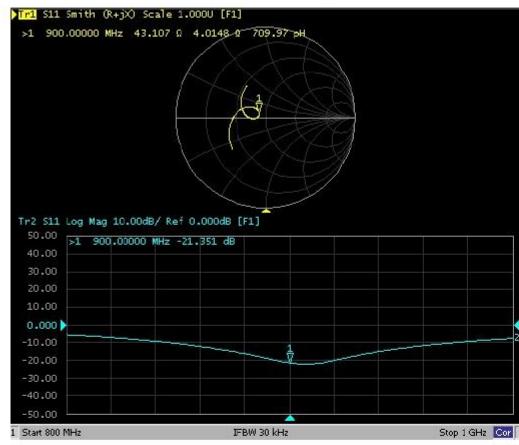
The return loss is <-20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

<Dipole Verification Data>- D900V2, serial no. 1d086

900MHz Head



900MHz Body



8.3 D1900V2 Dipole Calibration Certificate

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client SMQ (Auden)

Certificate No: D1900V2-5d194_Jan15

CALIBRATION CERTIFICATE

Object D1900V2 - SN: 5d194

Calibration procedure(s) QA CAL-05.v9
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: January 07, 2015

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	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390685 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by:	Name	Function	Signature
	Claudio Leubler	Laboratory Technician	

Approved by:	Name	Function	Signature
	Katja Pokrovic	Technical Manager	

Issued: January 7, 2015

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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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 0108

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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	40.1 ± 6 %	1.39 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.6 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.3 W/kg ± 16.5 % (k=2)

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 %	1.50 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.95 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.1 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.31 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.3 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	$53.7 \Omega + 4.9 \text{ j}\Omega$
Return Loss	- 24.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.9 \Omega + 5.1 \text{ j}\Omega$
Return Loss	- 25.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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	May 06, 2014

DASY5 Validation Report for Head TSL

Date: 07.12.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d194

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.39$ S/m; $\epsilon_r = 40.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5, 5, 5); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

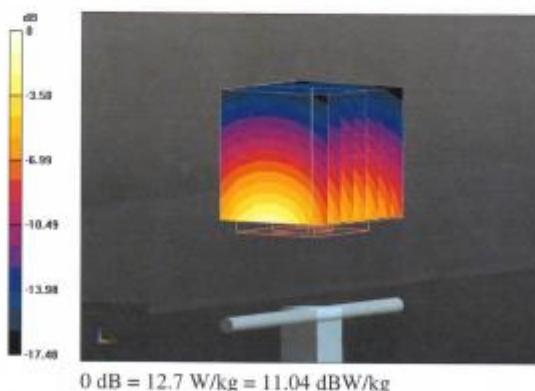
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.35 V/m; Power Drift = 0.04 dB

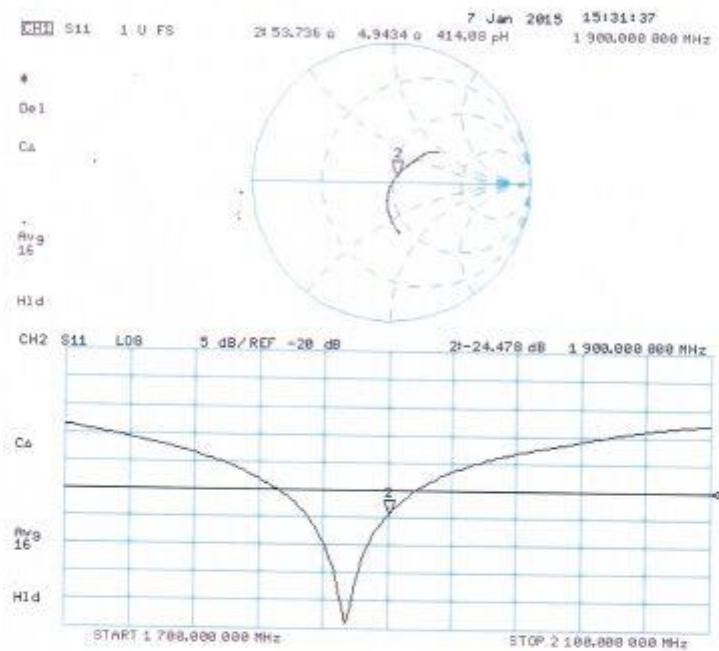
Peak SAR (extrapolated) = 18.5 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.32 W/kg

Maximum value of SAR (measured) = 12.7 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.01.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d194

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.5$ S/m; $\epsilon_r = 53.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

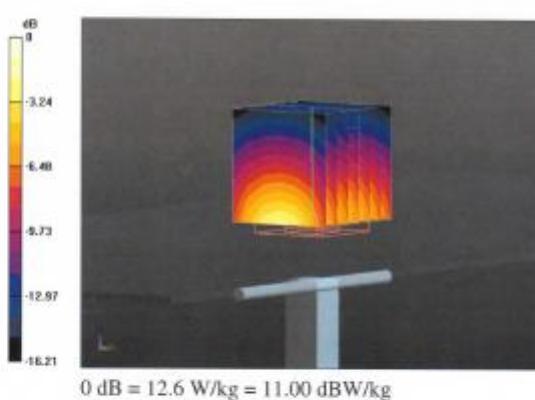
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.88 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 16.8 W/kg

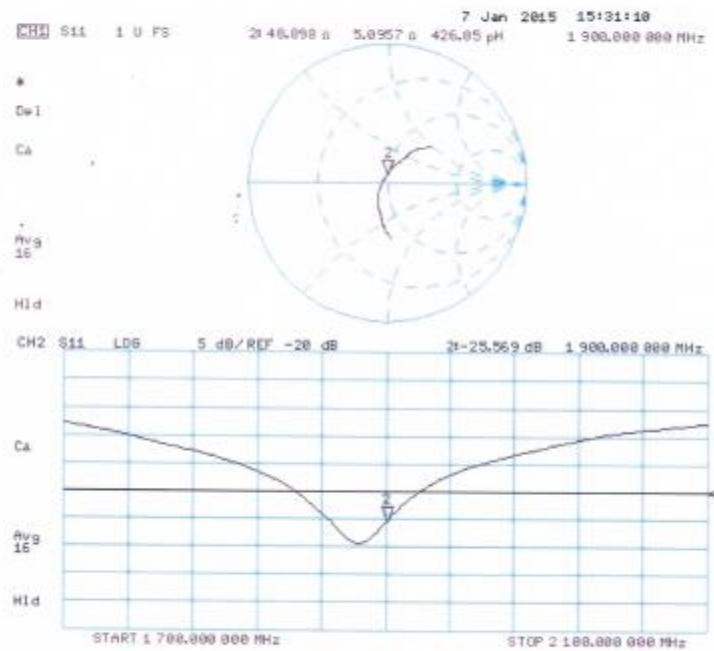
SAR(1 g) = 9.95 W/kg; SAR(10 g) = 5.31 W/kg

Maximum value of SAR (measured) = 12.6 W/kg



0 dB = 12.6 W/kg = 11.00 dBW/kg

Impedance Measurement Plot for Body TSL



8.4 DAE4 Calibration Certificate



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 E-mail: ctll@chinatll.com <http://www.chinatll.cn>



Client : **Auden**

Certificate No: Z15-97093

CALIBRATION CERTIFICATE			
Object	DAE4 - SN: 905		
Calibration Procedure(s)	FD-Z11-2-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)		
Calibration date:	July 16, 2015		
<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<70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p>			
Primary Standards	ID #	Cai Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	06-July-15 (CTTL, No:J15X04257)	July-16
Calibrated by:	Name	Function	Signature
	Yu Zongying	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	
Issued: July 17, 2015			
<p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p>			



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E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

Glossary:

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters:

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: ctl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

DC Voltage Measurement

A/D - Converter Resolution nominal
High Range: 1LSB = 6.1 μ V, full range = -100...+300 mV
Low Range: 1LSB = 61nV, full range = -1.....+3mV
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	$404.672 \pm 0.15\% \text{ (k=2)}$	$405.235 \pm 0.15\% \text{ (k=2)}$	$404.825 \pm 0.15\% \text{ (k=2)}$
Low Range	$3.98116 \pm 0.7\% \text{ (k=2)}$	$4.00286 \pm 0.7\% \text{ (k=2)}$	$3.99735 \pm 0.7\% \text{ (k=2)}$

Connector Angle

Connector Angle to be used in DASY system	$269^\circ \pm 1^\circ$
---	-------------------------

9 Test Setup Photos



Photograph of the depth in the Phantom (850MHz)



Photograph of the depth in the Phantom (1900MHz)



10mm Next to the mouth Setup Photo



0mm Wrist-worn Setup Photo

10 External and Internal Photos of the EUT

Please reference to the test report No.: CTL1606012027-WF-01

***** End of Report *****

