PROBE CALIBRATION CERTIFICATES

Client BA Chient Control Contr	633-2218 Fax: +86 ttl.com Http://w CL ERTIFICATE		CALIBI CNAS 97029
CALIBRATION C	ERTIFICATE		97029
Object			
and and head and			
	EX3DV4	- SN:7329	
Calibration Procedure(s)		1919	
	FF-Z11-0		
	Calibratio	on Procedures for Dosimetric E-field Probes	
Calibration date:	March 13	3, 2017	
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	I (IVIA I E CITUCALIO)	calibration)	
Primary Standards		calibration) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibrati
			Scheduled Calibrati
Primary Standards	ID # (Cal Date(Calibrated by, Certificate No.)	
Primary Standards Power Meter NRP2	ID # (Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Primary Standards Power Meter NRP2 Power sensor NRP-Z91	ID # (101919 101547 101548	Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777)	Jun-17 Jun-17
Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91	ID # (101919 101547 101548 18N50W-10dB	Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777)	Jun-17 Jun-17 Jun-17
Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference10dBAttenuator	ID # (101919 101547 101548 18N50W-10dB 18N50W-20dB	Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 13-Mar-16(CTTL,No.J16X01547)	Jun-17 Jun-17 Jun-17 Mar-18
Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference10dBAttenuator Reference20dBAttenuator	ID # (101919 101547 101548 18N50W-10dB 18N50W-20dB	Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 13-Mar-16(CTTL, No.J16X01547) 13-Mar-16(CTTL, No.J16X01548)	Jun-17 Jun-17 Jun-17 Mar-18 Mar-18
Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference10dBAttenuator Reference20dBAttenuator Reference Probe EX3DV4	ID # (101919 101547 101548 18N50W-10dB 18N50W-20dB SN 7433	Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 13-Mar-16(CTTL, No.J16X01547) 13-Mar-16(CTTL, No.J16X01548) 26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Jun-17 Jun-17 Jun-17 Mar-18 Mar-18 Sep-17
Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference10dBAttenuator Reference20dBAttenuator Reference Probe EX3DV4 DAE4	ID # (101919 101547 101548 18N50W-10dB 18N50W-20dB SN 7433 SN 549 ID #	Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 13-Mar-16(CTTL, No.J16X01547) 13-Mar-16(CTTL, No.J16X01548) 26-Sep-16(SPEAG, No.DAE4-549_Dec16) 13-Dec-16(SPEAG, No.DAE4-549_Dec16)	Jun-17 Jun-17 Jun-17 Mar-18 Mar-18 Sep-17 Dec -17
Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference10dBAttenuator Reference20dBAttenuator Reference Probe EX3DV4 DAE4 Secondary Standards	ID # (101919 101547 101548 18N50W-10dB 18N50W-20dB SN 7433 SN 549 ID # 6201052605	Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 13-Mar-16(CTTL, No.J16X01547) 13-Mar-16(CTTL, No.J16X01548) 26-Sep-16(SPEAG,No.EX3-7433_Sep16) 13-Dec-16(SPEAG, No.DAE4-549_Dec16) Cal Date(Calibrated by, Certificate No.)	Jun-17 Jun-17 Jun-17 Mar-18 Mar-18 Sep-17 Dec -17 Scheduled Calibration
Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference10dBAttenuator Reference20dBAttenuator Reference Probe EX3DV4 DAE4 Secondary Standards SignalGeneratorMG3700A Network Analyzer E5071C	ID # (101919 101547 101548 18N50W-10dB 18N50W-20dB SN 7433 SN 549 ID # 6201052605	Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 13-Mar-16(CTTL, No.J16X01547) 13-Mar-16(CTTL, No.J16X01548) 26-Sep-16(SPEAG, No.EX3-7433_Sep16) 13-Dec-16(SPEAG, No.DAE4-549_Dec16) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04776)	Jun-17 Jun-17 Jun-17 Mar-18 Mar-18 Sep-17 Dec -17 Scheduled Calibration Jun-17
Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference10dBAttenuator Reference20dBAttenuator Reference Probe EX3DV4 DAE4 Secondary Standards SignalGeneratorMG3700A Network Analyzer E5071C	ID # 0 101919 101547 101548 18N50W-10dB 18N50W-20dB SN 7433 SN 549 ID # 6201052605 MY46110673	Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 13-Mar-16(CTTL, No.J16X01547) 13-Mar-16(CTTL, No.J16X01548) 26-Sep-16(SPEAG,No.EX3-7433_Sep16) 13-Dec-16(SPEAG, No.DAE4-549_Dec16) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04776) 13-Jan-17 (CTTL, No.J17X00285) Function	Jun-17 Jun-17 Jun-17 Mar-18 Mar-18 Sep-17 Dec -17 Scheduled Calibration Jun-17 Jan -18 Signature
Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference10dBAttenuator Reference20dBAttenuator Reference Probe EX3DV4 DAE4 Secondary Standards SignalGeneratorMG3700A Network Analyzer E5071C Calibrated by:	ID # (101919 101547 101548 18N50W-10dB 18N50W-20dB SN 7433 SN 549 ID # 6201052605 MY46110673 Name	Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 13-Mar-16(CTTL, No.J16X01547) 13-Mar-16(CTTL, No.J16X01548) 26-Sep-16(SPEAG,No.EX3-7433_Sep16) 13-Dec-16(SPEAG, No.DAE4-549_Dec16) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04776) 13-Jan-17 (CTTL, No.J17X00285) Function	Jun-17 Jun-17 Jun-17 Mar-18 Mar-18 Sep-17 Dec -17 Scheduled Calibration Jun-17 Jan -18
Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference10dBAttenuator Reference20dBAttenuator Reference Probe EX3DV4 DAE4 Secondary Standards SignalGeneratorMG3700A Network Analyzer E5071C Calibrated by: Reviewed by:	ID # 0 101919 101547 101548 18N50W-10dB 18N50W-20dB SN 7433 SN 549 ID # 6201052605 MY46110673 Name Yu Zongying	Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 13-Mar-16(CTTL, No.J16X01547) 13-Mar-16(CTTL, No.J16X01548) 26-Sep-16(SPEAG, No.EX3-7433_Sep16) 13-Dec-16(SPEAG, No.DAE4-549_Dec16) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04776) 13-Jan-17 (CTTL, No.J17X00285) Function SAR Test Engineer	Jun-17 Jun-17 Jun-17 Mar-18 Mar-18 Sep-17 Dec -17 Scheduled Calibration Jun-17 Jan -18 Signature
Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference10dBAttenuator Reference20dBAttenuator Reference Probe EX3DV4 DAE4 Secondary Standards SignalGeneratorMG3700A Network Analyzer E5071C	ID # 0 101919 101547 101548 18N50W-10dB 18N50W-20dB SN 7433 SN 549 ID # 6201052605 MY46110673 Name Yu Zongying Qi Dianyuan	Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 13-Mar-16(CTTL, No.J16X01547) 13-Mar-16(CTTL, No.J16X01548) 26-Sep-16(SPEAG, No.EX3-7433_Sep16) 13-Dec-16(SPEAG, No.DAE4-549_Dec16) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04776) 13-Jan-17 (CTTL, No.J17X00285) Function SAR Test Engineer SAR Project Leader	Jun-17 Jun-17 Jun-17 Mar-18 Mar-18 Sep-17 Dec -17 Scheduled Calibration Jun-17 Jan -18 Signature

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Glossary:

tissue simulating liquid TSL NORMx,y,z sensitivity in free space ConvF sensitivity in TSL / NORMx.y.z DCP diode compression point CF crest factor (1/duty_cycle) of the RF signal A,B,C,D modulation dependent linearization parameters Φ rotation around probe axis Polarization Φ θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i Polarization 0

θ=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:

- a) 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
- 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) 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

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORMx,y,z: Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,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 (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.
- Ax,y,z; Bx,y,z; Cx,y,z; VRx,y,z: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≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,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±50MHz to±100MHz.
- 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).

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Probe EX3DV4

SN: 7329

Calibrated: March 13, 2017

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

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7329

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(µV/(V/m) ²) ^A	0.48	0.40	0.46	±10.8%
DCP(mV) ^B	98.5	102.2	98.9	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dBõV	C	D dB	VR mV	Unc ^E (k=2)
0 CW	0	X	0.0	0.0	1.0	0.00	188.1	±2.0%
		Y	0.0	0.0	1.0		170.5	1
		Z	0.0	0.0	1.0		184.3	

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 Page 5 and Page 6).

 ^B Numerical linearization parameter: uncertainty not required.
 ^E Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7329

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)	Unct. (k=2)
750	41.9	0.89	9.69	9.69	9.69	0.30	0.80	±12%
900	41.5	0.97	9.36	9.36	9.36	0.16	1.24	±12%
1750	40,1	1.37	8.36	8.36	8.36	0.28	0.96	±12%
1900	40.0	1.40	8.18	8.18	8.18	0.26	0.99	±12%
2450	39.2	1.80	7.61	7.61	7.61	0.34	1.06	±12%
2600	39.0	1.96	7.36	7.36	7.36	0.50	0.78	±12%
5250	35.9	4.71	5.44	5.44	5.44	0.40	1.15	±13%
5600	35.5	5.07	4.80	4.80	4.80	0.42	1.40	±13%
5750	35.4	5.22	4.71	4.71	4.71	0.45	1.50	±13%

^c Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of 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 frequency 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 \pm 1% for frequencies below 3 GHz and below \pm 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Certificate No: Z17-97029

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DASY/EASY - Parameters of Probe: EX3DV4 - SN: 7329

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)	Unct. (k=2)
750	55.5	0.96	9.91	9.91	9.91	0.30	0.90	±12%
900	55.0	1.05	9.58	9.58	9.58	0.27	1.09	±12%
1750	53.4	1.49	8.13	8.13	8,13	0.21	1.08	±12%
1900	53.3	1.52	7.77	7.77	7.77	0.19	1.21	±12%
2450	52.7	1.95	7.37	7.37	7.37	0.36	1.11	±12%
2600	52.5	2.16	7.24	7.24	7.24	0.47	0.86	±12%
5250	48.9	5.36	4.84	4.84	4.84	0.50	1.58	±13%
5600	48.5	5.77	4.12	4.12	4.12	0.57	1.55	±13%
5750	48.3	5.94	4.48	4.48	4.48	0.57	1.52	±13%

^c Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of 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 frequency 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 \pm 1% for frequencies below 3 GHz and below \pm 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

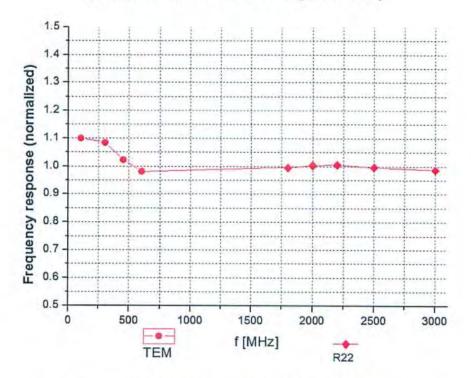
Certificate No: Z17-97029

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Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209 E-mail: ettl@chinattl.com <u>Http://www.chinattl.cn</u>

Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.5% (k=2)

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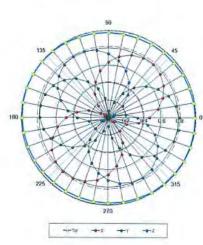
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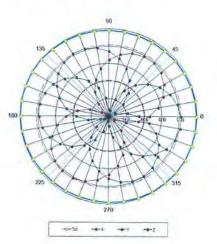


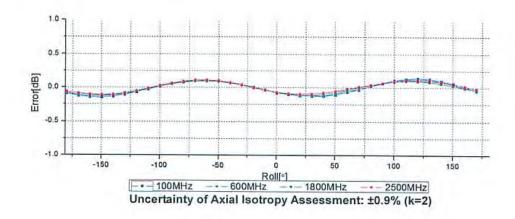
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM

f=1800 MHz, R22

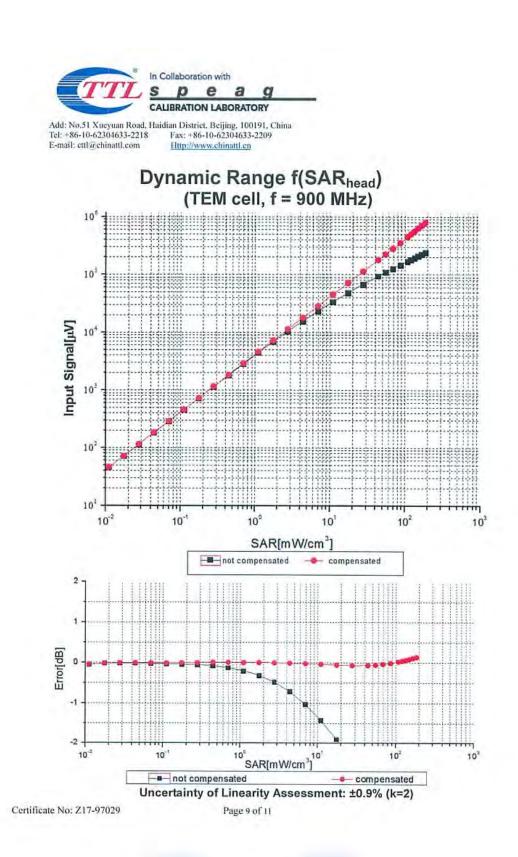






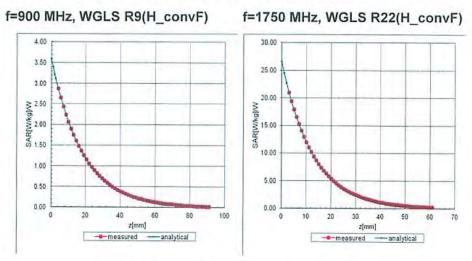
Certificate No: Z17-97029

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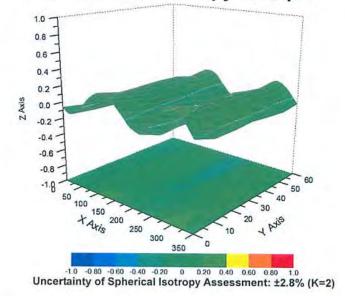




Conversion Factor Assessment



Deviation from Isotropy in Liquid



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DASY/EASY - Parameters of Probe: EX3DV4 - SN: 7329

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	30.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

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DIPOLE CALIBRATION CERTIFICATES

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



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

Accreditation No.: SCS 0108

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

CALIBRATION CERTIFICATE

Client BACL

Certificate No: D750V3-1167_Nov16

Object	D750V3 - SN:11	67	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	edure for dipole validation kits ab	ove 700 MHz
Calibration date:	November 08, 20	016	
This calibration certificate docume	ents the traceability to nat	ional standards, which realize the physical ur	nits of measurements (SI).
The measurements and the uncer	rtainties with confidence p	probability are given on the following pages ar	nd are part of the certificate.
All calibrations have been conduc	ted in the closed laborato	ry facility: environment temperature $(22 \pm 3)^{\circ}$	C and humidity - 70%
	the closed laborato	ry memory, environment temperature (22 \pm 3)*	c and numberly < 70%.
Calibration Equipment used (M&T	E critical for calibration)		
Primary Standards	10 #	Col Date (Contract No.)	
	10 #	Cal Date (Certificate No.)	Scheduled Calibration
the second s	SN: 104778	06.Apr. 16 (No. 217.02288/02280)	Anc 17
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power meter NRP Power sensor NR P-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power meter NRP Power sensor NR P-Z91 Power sensor NR P-Z91	SN: 103244 SN: 103245	06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289)	Apr-17 Apr-17
Power meter NRP Power sensor NR P-Z91 Power sensor NR P-Z91 Reference 20 dB Attenuator	SN: 103244 SN: 103245 SN: 5058 (20k)	06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02282)	Apr-17 Apr-17 Apr-17
Power meter NRP Power sensor NR P-Z91 Power sensor NR P-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295)	Apr-17 Apr-17 Apr-17 Apr-17
Power meter NRP Power sensor NR P-Z91 Power sensor NR P-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 103244 SN: 103245 SN: 5058 (20k)	06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02282)	Apr-17 Apr-17 Apr-17
Power meter NRP Power sensor NR P-Z91 Power sensor NR P-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16)	Apr-17 Apr-17 Apr-17 Apr-17 Jun-17
Power meter NRP Power sensor NR P-Z91 Power sensor NR P-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15)	Apr-17 Apr-17 Apr-17 Apr-17 Jun-17 Dec-16 Scheduled Check
Power meter NRP Power sensor NR P-Z91 Power sensor NR P-Z91 Reference: 20 dB Attenuator Type-N mismatch combination Reference: Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15) Check Date (in house)	Apr-17 Apr-17 Apr-17 Apr-17 Jun-17 Dicc-16
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference: 20 dB Attenuator Type-N mismatch combination Reference: Probe EX3DV4 DAE4 Secondary Standards	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2706327 SN: 7349 SN: 601 ID # SN: GB37480704	06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	Apr-17 Apr-17 Apr-17 Apr-17 Jun-17 Dec-16 Scheduled Check In house check: Oct-18
Power meter NRP Power sensor NR P-Z91 Power sensor NR P-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783	06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15) Check Date (In house) 07-Oct-15 (In house check Oct-16)	Apr-17 Apr-17 Apr-17 Jun-17 Jun-17 Dec-16 Scheduled Check In house check: Oct-18 In house check: Oct-18
Power meter NRP Power sensor NR P-Z91 Power sensor NR P-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317	06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15) Check Date (in house) 07-Oct+15 (in house check Oct-16) 07-Oct+15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	Apr-17 Apr-17 Apr-17 Jun-17 Jun-17 Dec-16 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference: 20 dB Attenuator Type-N mismatch combination Reference: Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-Q6	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972	06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 16-Jun-15 (in house check Oct-16)	Apr-17 Apr-17 Apr-17 Jun-17 Dec-16 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference: 20 dB Attenuator Type-N mismatch combination Reference: Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-Q6	SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: WY41092317 SN: WY410922 SN: US37390585	06-Apr-16 (No. 217-02288) 06-Apr-16 (No. 217-02289) 05-Apr-16 (No. 217-02292) 05-Apr-16 (No. 217-02295) 15-Jun-16 (No. 217-02295) 15-Jun-16 (No. EX3-7349_Jun16) 30-Dec-15 (No. DAE4-601_Dec15) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 18-Oct-01 (in house check Oct-16)	Apr-17 Apr-17 Apr-17 Jun-17 Dec-16 Scheduled Check In house check: Oct-18 In house check: Oct-18

Certificate No: D750V3-1167_Nov16

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



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Accreditation No.: SCS 0108

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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

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 1528-2013, "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
- 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) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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%.

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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	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.1 ± 6 %	0.92 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	2.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.23 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ² (10 g) of Head TSL SAR measured	condition 250 mW input power	1.38 W/kg

Body TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.6 ± 6 %	0.97 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	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.58 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.69 W/kg ± 16.5 % (k=2)

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.1 Ω - 3.7 jΩ
Return Loss	- 25.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.8 Ω - 5.4 jΩ
Return Loss	- 25.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.033 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	October 10, 2016

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DASY5 Validation Report for Head TSL

Date: 08.11.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1167

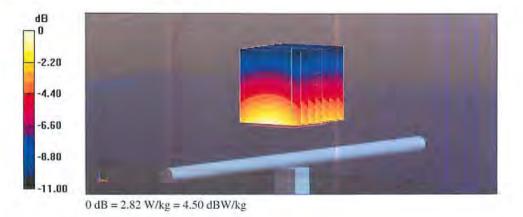
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; σ = 0.92 S/m; ϵ_r = 41.1; p = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.07, 10.07, 10.07); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- · Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

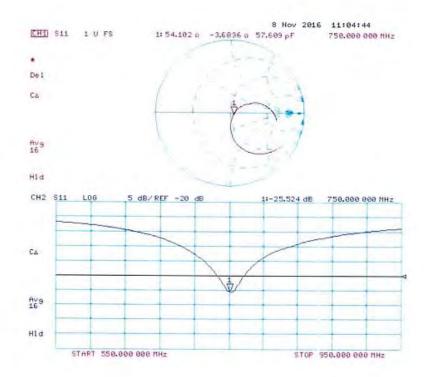
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 58.22 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 3.17 W/kg SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.38 W/kg Maximum value of SAR (measured) = 2.82 W/kg



Certificate No: D750V3-1167_Nov16

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Impedance Measurement Plot for Head TSL



Certificate No: D750V3-1167_Nov16

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DASY5 Validation Report for Body TSL

Date: 08.11.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1167

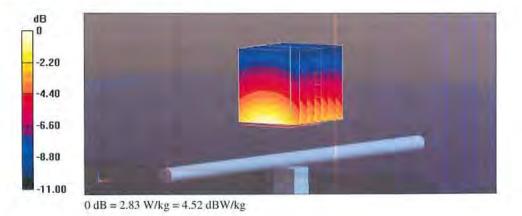
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; $\sigma = 0.97$ S/m; $\epsilon_f = 55.6$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.99, 9.99, 9.99); Calibrated: 15.06.2016;
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

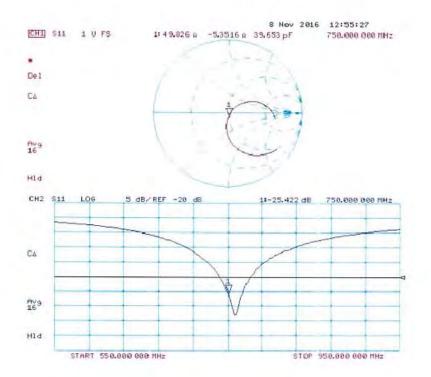
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 56.52 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.20 W/kg SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.43 W/kg Maximum value of SAR (measured) = 2.83 W/kg



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Impedance Measurement Plot for Body TSL



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Object		
	D835V2 - SN: 445	
Calibration Procedure(s)	FD-Z11-003-01	
	Calibration Procedures for dipole validation	kits
Calibration date:	October 26, 2016	
pages and are part of the certificate All calibrations have been condu humidity<70%.	ucted in the closed laboratory facility: env	ironment temperature(22±3)℃ and
	Cal Date(Calibrated by, Certificate 27-Jun-16 (CTTL, No.J16X04777	7) Jun-17
Primary Standards ID # Power Meter NRP2 1019	Cal Date(Calibrated by, Certificate 27-Jun-16 (CTTL, No.J16X04777 27-Jun-16 (CTTL, No.J16X04777	7) Jun-17 7) Jun-17
Primary StandardsID #Power MeterNRP21019Power sensor NRP-Z911015	Cal Date(Calibrated by, Certificate 119 27-Jun-16 (CTTL, No.J16X04777 147 27-Jun-16 (CTTL, No.J16X04777 1433 26-Sep-16(SPEAG,No.EX3-7433	7) Jun-17 7) Jun-17 _Sep16) Sep-17
Primary Standards ID # Power Meter NRP2 1019 Power sensor NRP-Z91 1015 Reference Probe EX3DV4 SN 7	Cal Date(Calibrated by, Certificate 219 27-Jun-16 (CTTL, No.J16X04777 247 27-Jun-16 (CTTL, No.J16X04777 2433 26-Sep-16(SPEAG,No.EX3-7433 277 22-Aug-16(CTTL-SPEAG,No.Z16)	7) Jun-17 7) Jun-17 (_Sep16) Sep-17 3-97138) Aug-17
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Primary Standards ID # Power Meter NRP2 1019 Power sensor NRP-Z91 1015 Reference Probe EX3DV4 SN 7 DAE4 SN 7 Secondary Standards ID # Signal Generator E4438C MY4 Network Analyzer E5071C MY4	Cal Date(Calibrated by, Certificated 219 27-Jun-16 (CTTL, No.J16X04777 247 27-Jun-16 (CTTL, No.J16X04777 243 26-Sep-16(SPEAG,No.EX3-7433 277 22-Aug-16(CTTL-SPEAG,No.Z16 Cal Date(Calibrated by, Certificated by, Certificated 9071430 01-Feb-16 (CTTL, No.J16X00894 6110673 26-Jan-16 (CTTL, No.J16X00894	Z) Jun-17 Z) Jun-17 Z) Sep-17 S-97138) Aug-17 e No.) Scheduled Calibration 3) Jan-17 4) Jan-17
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Primary Standards ID # Power Meter NRP2 1019 Power sensor NRP-Z91 1015 Reference Probe EX3DV4 SN 7 DAE4 SN 7 Secondary Standards ID # Signal Generator E4438C MY4 Network Analyzer E5071C MY4	Cal Date(Calibrated by, Certificated 219 27-Jun-16 (CTTL, No.J16X04777 247 27-Jun-16 (CTTL, No.J16X04777 243 26-Sep-16(SPEAG,No.EX3-7433 277 22-Aug-16(CTTL-SPEAG,No.Z16 Cal Date(Calibrated by, Certificated by, Certificated 9071430 01-Feb-16 (CTTL, No.J16X00894 6110673 26-Jan-16 (CTTL, No.J16X00894 11 Function	Z) Jun-17 Z) Jun-17 Z) Sep-17 S-97138) Aug-17 e No.) Scheduled Calibration 3) Jan-17 4) Jan-17
Power Meter NRP2 1019 Power sensor NRP-Z91 1015 Reference Probe EX3DV4 SN 7 DAE4 SN 7 Secondary Standards ID # Signal Generator E4438C MY4 Network Analyzer E5071C MY4 Calibrated by: Zhao	Cal Date(Calibrated by, Certificated 219 27-Jun-16 (CTTL, No.J16X04777 247 27-Jun-16 (CTTL, No.J16X04777 243 26-Sep-16(SPEAG,No.EX3-7433 277 22-Aug-16(CTTL-SPEAG,No.Z16 Cal Date(Calibrated by, Certificated by, Certificated 9071430 01-Feb-16 (CTTL, No.J16X00894 6110673 26-Jan-16 (CTTL, No.J16X00894 11 Function	Z) Jun-17 Z) Jun-17 Z) Jun-17 Z) Sep-17 S-97138) Aug-17 e No.) Scheduled Calibration 3) Jan-17 4) Jan-17

Certificate No: Z16-97195

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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 1528-2013, "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
- 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) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) 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%.

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Measurement Conditions

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

DASY Version	DASY52	52.8.8.1258
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
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	41.4 ± 6 %	0.92 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.41 mW/g
SAR for nominal Head TSL parameters	normalized to 1W	9.46 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.58 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.23 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	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.8 ± 6 %	0.95 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.36 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.60 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.59 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.44 mW /g ± 20.4 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	45.5Ω- 3.43jΩ
Return Loss	- 24.6dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.5Ω- 7.29jΩ	
Return Loss	- 22.1dB	

General Antenna Parameters and Design

Electrical Delay (one direction) 1.497 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
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Certificate No: Z16-97195

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DASY5 Validation Report for Head TSL

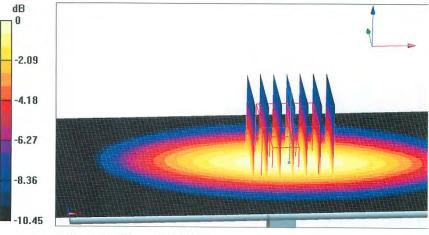
Date: 10.26.2016

Test Laboratory: CTTL, Beijing, China **DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 445** Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: f = 835 MHz; σ = 0.922 S/m; ϵ_r = 41.42; ρ = 1000 kg/m³ Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN7433; ConvF(9.82, 9.82, 9.82); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 2016-08-22
- Phantom: Triple Flat Phantom 5,1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

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

Reference Value = 58.51 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 3.63 W/kg SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.58 W/kg Maximum value of SAR (measured) = 3.07 W/kg



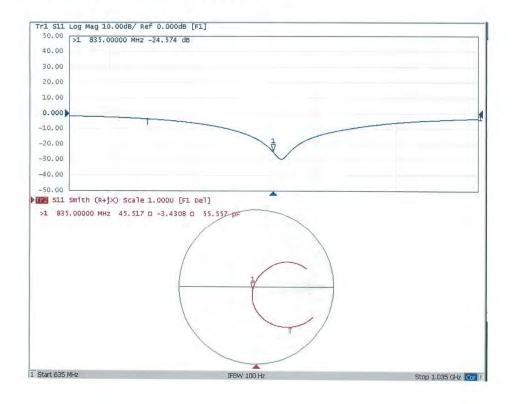
0 dB = 3.07 W/kg = 4.87 dBW/kg

Certificate No: Z16-97195

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Impedance Measurement Plot for Head TSL



Certificate No: Z16-97195

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Http://www.chinattl.cn

DASY5 Validation Report for Body TSL Test Laboratory: CTTL, Beijing, China

Date: 10.26.2016

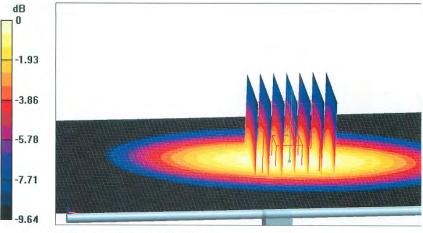
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 445 Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: f = 835 MHz; $\sigma = 0.952$ S/m; $\epsilon_r = 55.79$; $\rho = 1000$ kg/m³ Phantom section: Center Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN7433; ConvF(9.5,9.5, 9.5); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 2016-08-22 .
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1 •
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372) .

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 56.01 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.44 W/kg SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 2.95 W/kg



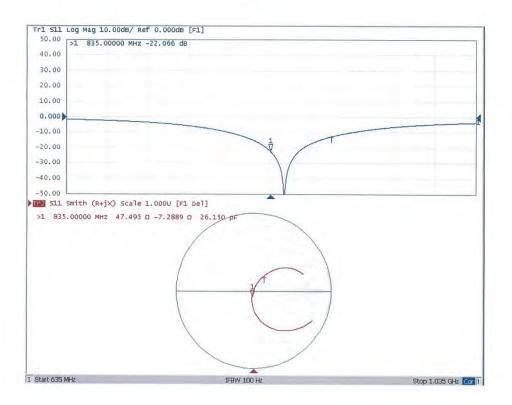
0 dB = 2.95 W/kg = 4.70 dBW/kg

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Impedance Measurement Plot for Body TSL



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

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Accreditation No.: SCS 0108

Issued: July 14, 2015

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BACL Client Certificate No: D1750V2-1141_Jul15 CALIBRATION CERTIFICATE Object D1750V2 - SN:1141 QA CAL-05.v9 Calibration procedure(s) Calibration procedure for dipole validation kits above 700 MHz Colibration date: July 09, 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) 01-Apr-15 (No. 217-02131) Mar-16 SN: 5047.2 / 06327 Typo-N mismatch combination 01-Apr-15 (No. 217-02134) Mar-16 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 US37390585 S4206 18-Oct-01 (in house check Oct-14) In house check: Oct-15 Name Function Calibrated by: Claudio Laubler Laboratory Technician Katja Pokovic Approved by: Technical Manager

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

Certificate No: D1750V2-1141_Jul15

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Accreditation No.: SCS 0108

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and a date ye	
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 1528-2013, "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
- 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
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless C) communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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%.

Certificate No: D1750V2-1141_Jul15

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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	1750 MHz ± 1 MHz	

Head TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.8 ± 6 %	1.38 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	9.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.8 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.97 W/kg

Body TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.2 ± 6 %	1.48 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	9.37 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.4 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.07 W/kg

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.1 Ω - 0.1 jΩ
Return Loss	- 39.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.6 Ω + 0.3 jΩ
Return Loss	- 29.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.225 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	September 30, 2014

Certificate No: D1750V2-1141_Jul15

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DASY5 Validation Report for Head TSL

Date: 09.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1141

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; $\sigma = 1.38$ S/m; $\epsilon_r = 38.8$; p = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(5.2, 5.2, 5.2); 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)

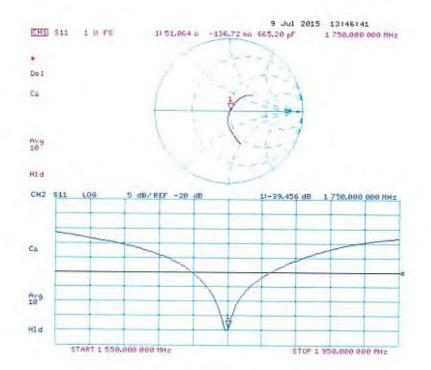
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 93.34 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 16.6 W/kg SAR(1 g) = 9.31 W/kg; SAR(10 g) = 4.97 W/kg Maximum value of SAR (measured) = 11.3 W/kg



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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 09.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1141

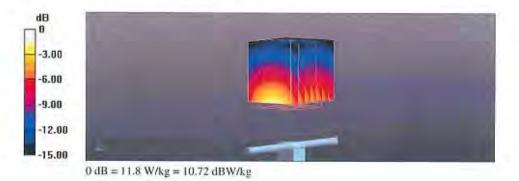
Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; σ = 1.48 S/m; ϵ_r = 52.2; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(4.88, 4.88, 4.88); 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

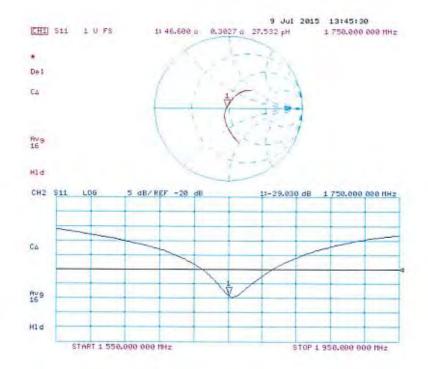
Reference Value = 92.95 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 15.9 W/kg SAR(1 g) = 9.37 W/kg; SAR(10 g) = 5.07 W/kg Maximum value of SAR (measured) = 11.8 W/kg



Certificate No: D1750V2-1141_Jul15

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Impedance Measurement Plot for Body TSL



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		trict, Beijing, 100191, China 👘	CALIBRATION
Tel: +86-10-623046 E-mail: cttl@chinat	33-2079 Fax: # 11.com Http://	86-10-62304633-2504	CNAS L0570
Client BAC			6-97196
CALIBRATION CI	ERTIFICAT	E	
Dbject	D1900	/2 - SN: 543	
alibration Procedure(s)	ED 744	-003-01	
		tion Procedures for dipole validation kits	
Calibration date:	Octobe	r 25, 2016	
	asurements and	the uncertainties with confidence probability	are given on the following
ages and are part of the ce	ertificate.	the uncertainties with confidence probability the closed laboratory facility: environment or calibration)	
ages and are part of the ce II calibrations have been umidity<70%. Calibration Equipment used	ertificate.	the closed laboratory facility: environment	
ages and are part of the ce unidity<70%. Calibration Equipment used rimary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4	ID # 101547	the closed laboratory facility: environment or calibration)	temperature(22±3) [*] C and
ages and are part of the ce Il calibrations have been umidity<70%.	ID # 101547 SN 7433	the closed laboratory facility: environment or calibration) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 26-Sep-16(SPEAG,No.EX3-7433_Sep16) 22-Aug-16(CTTL-SPEAG,No.Z16-97138)	temperature(22±3)°C and Scheduled Calibration Jun-17 Jun-17 Sep-17
ages and are part of the ce II calibrations have been umidity<70%. Calibration Equipment used 'rimary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ertificate. conducted in (M&TE critical for ID # 101919 101547 SN 7433 SN 777	the closed laboratory facility: environment or calibration) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 26-Sep-16(SPEAG,No.EX3-7433_Sep16)	temperature(22±3)℃ and Scheduled Calibration Jun-17 Jun-17 Sep-17 Aug-17
ages and are part of the ce II calibrations have been umidity<70%. Calibration Equipment used 'rimary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ertificate. conducted in (M&TE critical for ID # 101919 101547 SN 7433 SN 777 ID # MY49071430	the closed laboratory facility: environment or calibration) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 26-Sep-16(SPEAG,No.EX3-7433_Sep16) 22-Aug-16(CTTL-SPEAG,No.Z16-97138) Cal Date(Calibrated by, Certificate No.) 01-Feb-16 (CTTL, No.J16X00893)	temperature(22±3)°C and Scheduled Calibration Jun-17 Jun-17 Sep-17 Aug-17 Scheduled Calibration Jan-17 Jan-17
ages and are part of the ce unidity<70%. Calibration Equipment used rimary Standards Power Meter NRP2 Power Sensor NRP-Z91 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C Network Analyzer E5071C	ertificate. conducted in (M&TE critical for ID # 101919 101547 SN 7433 SN 777 ID # MY49071430 MY46110673	the closed laboratory facility: environment or calibration) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 26-Sep-16(SPEAG,No.EX3-7433_Sep16) 22-Aug-16(CTTL-SPEAG,No.Z16-97138) Cal Date(Calibrated by, Certificate No.) 01-Feb-16 (CTTL, No.J16X00893) 26-Jan-16 (CTTL, No.J16X00894)	temperature(22±3)℃ and Scheduled Calibration Jun-17 Jun-17 Sep-17 Aug-17 Scheduled Calibration Jan-17
ages and are part of the ce unidity<70%. Calibration Equipment used 'rimary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4	ertificate. conducted in (M&TE critical for 10 # 101919 101547 SN 7433 SN 777 ID # MY49071430 MY46110673 Name	the closed laboratory facility: environment or calibration) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 26-Sep-16(SPEAG,No.EX3-7433_Sep16) 22-Aug-16(CTTL-SPEAG,No.Z16-97138) Cal Date(Calibrated by, Certificate No.) 01-Feb-16 (CTTL, No.J16X00893) 26-Jan-16 (CTTL, No.J16X00894) Function	temperature(22±3)℃ and Scheduled Calibration Jun-17 Jun-17 Sep-17 Aug-17 Scheduled Calibration Jan-17 Jan-17

Certificate No: Z16-97196

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Glossary: TSL

ConvF

N/A

tissue simulating liquid sensitivity in TSL / NORMx,y,z not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) 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
- 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) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) 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%.

Certificate No: Z16-97196

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 Fax: +86-10-62304633-2504

 E-mail: cttl@chinattl.com
 Http://www.chinattl.cn

Measurement Conditions

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

DASY Version	DASY52	52.8.8.1258
DAST VEISION	DA3132	52,8,6,1256
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
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	<1.0 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.3 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.25 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.1 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	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.6±6%	1.50 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	41.1 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.40 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.7 mW /g ± 20.4 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.1Ω+ 4.37jΩ
Return Loss	- 27.2dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.9Ω+ 3.77jΩ	
Return Loss	- 25.9dB	

General Antenna Parameters and Design

Electrical Delay (one direction) 1.304 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

Certificate No: Z16-97196

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Add: No.51 Xueyuan Road, H	
Tel: +86-10-62304633-2079	
E-mail: cttl@chinattl.com	

DASY5 Validation Report for Head TSL

laidian District, Beijing, 100191, China Fax: +86-10-62304633-2504 Http://www.chinattl.cn

Date: 10.25.2016

Test Laboratory: CTTL, Beijing, China DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 543

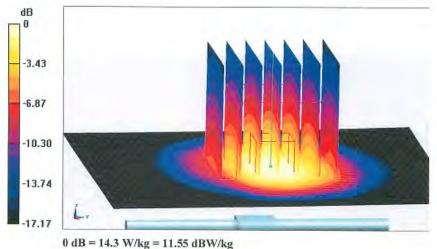
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz; σ = 1.385 S/m; ϵ r = 40.11; ρ = 1000 kg/m3 Phantom section: Center Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 SN7433; ConvF(7.98, 7.98, 7.98); Calibrated: 9/26/2016;
- · Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 2016-08-22
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

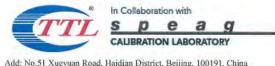
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 98.24 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 18.2 W/kg

SAR(1 g) = 10 W/kg; SAR(10 g) = 5.25 W/kg Maximum value of SAR (measured) = 14.3 W/kg



Certificate No: Z16-97196

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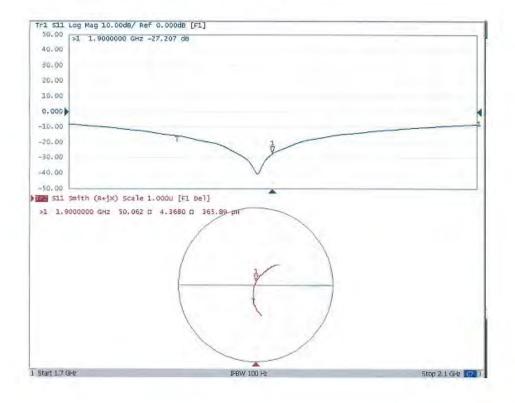


 Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

 E-mail: ettl@chinattl.com
 Http://www.chinattl.en

Impedance Measurement Plot for Head TSL



Certificate No: Z16-97196

Page 6 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 E-mail: cttl@chinattl.com

DASY5 Validation Report for Body TSL

Fax: +86-10-62304633-2504 Http://www.chinattl.en

Date: 10.25.2016

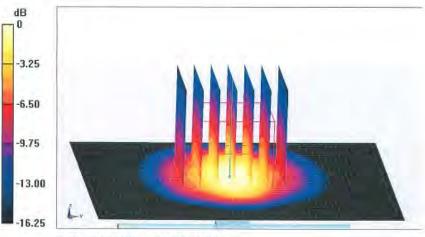
Test Laboratory: CTTL, Beijing, China DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 543 Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz; σ = 1.504 S/m; ϵ_r = 53.55; ρ = 1000 kg/m³ Phantom section: Center Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

Probe: EX3DV4 - SN7433; ConvF(7.7, 7.7, 7.7); Calibrated: 9/26/2016;

- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 2016-08-22 .
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1 .
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 99.20 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 17.9 W/kg SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.4 W/kg Maximum value of SAR (measured) = 14.4 W/kg



0 dB = 14.4 W/kg = 11.58 dBW/kg

Certificate No: Z16-97196

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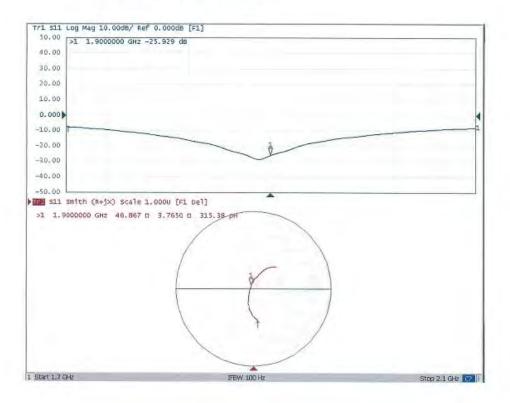


 Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

 E-mail: cttl@chinattl.com
 Http://www.chinattl.cn

Impedance Measurement Plot for Body TSL



Certificate No: Z16-97196

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



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Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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BACL Client

Certificate No: D2450V2-971_Jul15

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Object	D2450V2 - SN:97	71	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	dure for dipole validation kits abc	ove 700 MHz
Calibration date:	July 08, 2015		
The measurements and the unce	rtainties with confidence p cted in the closed laborator	ional standards, which realize the physical un robability are given on the following pages an ry facility: environment temperature $(22 \pm 3)^{\circ}$	d are part of the certificate.
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Primary Standards Power meter EPM-442A	ID # GB37480704	Cal Date (Certificate No.) 07-Oct-14 (No. 217-02020)	Oct-15
Power meter EPM-442A Power sensor HP 8481A	GB37480704 US37292783	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020)	Oct-15 Oct-15
Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A	GB37480704 US37292783 MY41092317	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021)	Oct-15 Oct-15 Oct-15
Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator	GB37480704 US37292783 MY41092317 SN: 5058 (20k)	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131)	Oct-15 Oct-15 Oct-15 Mar-16
Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134)	Oct-15 Oct-15 Oct-15 Mar-16 Mar-16
Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3	GB37480704 US37292783 MY41092317 SN: 5058 (20k)	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131)	Oct-15 Oct-15 Oct-15 Mar-16
	GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. ES3-3205_Dec14)	Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15
Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4	GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. ES3-3205_Dec14) 18-Aug-14 (No. DAE4-601_Aug14)	Oct-15 Oct-15 Oct-15 Mar-16 Dec-15 Aug-15
Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards RF generator R&S SMT-06	GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601 ID #	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. 217-02134) 18-Aug-14 (No. DAE4-601_Aug14) Check Date (in house)	Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15 Aug-15 Scheduled Check
Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards	GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601 ID # 100005 US37390585 S4206	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. ES3-3205_Dec14) 18-Aug-14 (No. DAE4-601_Aug14) Check Date (in house) 04-Aug-99 (in house check Oct-13) 18-Oct-01 (in house check Oct-14)	Oct-15 Oct-15 Oct-15 Mar-16 Dec-15 Aug-15 Scheduled Check In house check: Oct-16 In house check: Oct-15
Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards RF generator R&S SMT-06 Network Analyzer HP 8753E	GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 601 ID # 100005 US37390585 S4206 Name	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. ES3-3205_Dec14) 18-Aug-14 (No. DAE4-601_Aug14) Check Date (in house) 04-Aug-99 (in house check Oct-13) 18-Oct-01 (in house check Oct-14) Function	Oct-15 Oct-15 Oct-15 Mar-16 Mar-16 Dec-15 Aug-15 Scheduled Check In house check: Oct-16
Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards RF generator R&S SMT-06	GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601 ID # 100005 US37390585 S4206	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. ES3-3205_Dec14) 18-Aug-14 (No. DAE4-601_Aug14) Check Date (in house) 04-Aug-99 (in house check Oct-13) 18-Oct-01 (in house check Oct-14)	Oct-15 Oct-15 Oct-15 Mar-16 Dec-15 Aug-15 Scheduled Check In house check: Oct-16 In house check: Oct-15
Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards RF generator R&S SMT-06 Network Analyzer HP 8753E	GB37480704 US37292783 MY41092317 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 601 ID # 100005 US37390585 S4206 Name	07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02020) 07-Oct-14 (No. 217-02021) 01-Apr-15 (No. 217-02131) 01-Apr-15 (No. 217-02134) 30-Dec-14 (No. ES3-3205_Dec14) 18-Aug-14 (No. DAE4-601_Aug14) Check Date (in house) 04-Aug-99 (in house check Oct-13) 18-Oct-01 (in house check Oct-14) Function	Oct-15 Oct-15 Oct-15 Mar-16 Dec-15 Aug-15 Scheduled Check In house check: Oct-16 In house check: Oct-15

Certificate No: D2450V2-971_Jul15

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



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Accreditation No.: SCS 0108

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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 1528-2013, "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
- 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) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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%.

Certificate No: D2450V2-971_Jul15

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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	2450 MHz ± 1 MHz	

Head TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.9 ± 6 %	1.88 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	13.7 W/kg
SAR for nominal Head TSL parameters	ad TSL parameters normalized to 1W	
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
	condition	
SAR measured	250 mW input power	6.40 W/kg

Body TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.4 ± 6 %	2.03 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	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.6 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.05 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.9 W/kg ± 16.5 % (k=2)

Certificate No: D2450V2-971_Jul15

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.5 Ω + 1.9 jΩ
Return Loss	- 28.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.5 Ω + 3.6 jΩ
Return Loss	- 28.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.155 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	December 30, 2014

Certificate No: D2450V2-971_Jul15

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DASY5 Validation Report for Head TSL

Date: 08.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:971

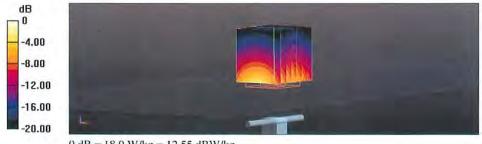
Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; σ = 1.88 S/m; ϵ_r = 37.9; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(4.54, 4.54, 4.54); 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:

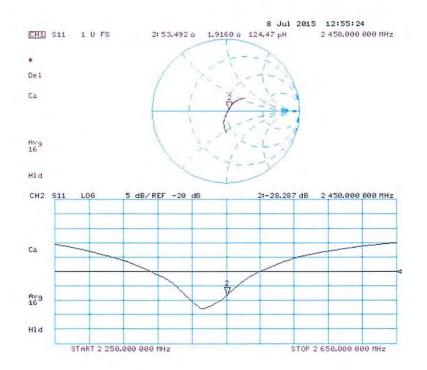
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 101.3 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 28.1 W/kg SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.4 W/kg Maximum value of SAR (measured) = 18.0 W/kg



0 dB = 18.0 W/kg = 12.55 dBW/kg

Certificate No: D2450V2-971_Jul15

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Impedance Measurement Plot for Head TSL

Certificate No: D2450V2-971_Jul15

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DASY5 Validation Report for Body TSL

Date: 08.07.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:971

Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; σ = 2.03 S/m; ϵ_r = 52.4; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(4.32, 4.32, 4.32); 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:

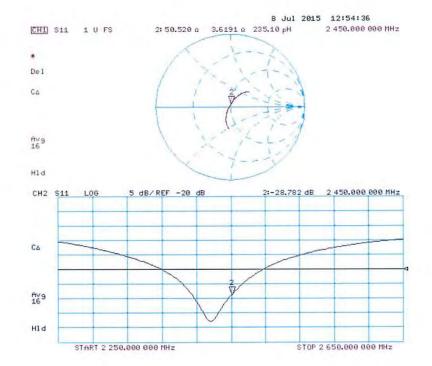
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 94.67 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 26.4 W/kg SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.05 W/kg Maximum value of SAR (measured) = 17.0 W/kg



0 dB = 17.0 W/kg = 12.30 dBW/kg

Certificate No: D2450V2-971_Jul15

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Impedance Measurement Plot for Body TSL

Certificate No: D2450V2-971_Jul15

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DIPOLE CALIBRATION CERTIFICATES

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



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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

Client BACL Accreditation Nc.: SCS 0108

Certificate No: D2600V2-1132 Nov16 CALIBRATION CERTIFICATE Object D26C0V2 - SN:1132 Calibration procedure(s) QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz November 10, 2016 Calibration date: 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 faboratory facility: environment temperature (22 ± 3)°C and humidity < 70%, Calibration Equipment used (M&TE critical for calibration) Primary Standards ID # Cal Date (Certificate No.) Schedulad Calibration Power meter NRP SN: 104778 06-Apr-16 (No. 217-02283/02289) Apr-17 Power sensor NRP-Z91 SN: 103244 06-Apr-16 (No. 217-02283) Apr-17 Power sensor NRP-Z31 SN: 103245 06-Apr-16 (No. 217-02283) Apr-17 Reference 20 dB Attenuator SN: 5058 (20k) 05-Apr-16 (No. 217-02292) Apr-17 Type-N mismatch compination SN: 5047.27 06327 05-Apr-16 (No. 217-02295) Apr-17 Reference Probe EX2DV4 SN: 7349 15-Jun-16 (No. EX3-7349 Jun16) Jun-17 DAE4 30-Dec-15 (No. DAE4-601_Dec15) SN: 601 Dec-16 Secondary Standards 1D # Check Date (in house) Scheduled Check In house check: Od-18 Power meter EPM-442A SN: GB37480704 07-Oct-15 (in house check Oct-16) Power sensor HP B4E1A SN: U537292783 07-Oct-15 (in house check Oct-16) In house check: Ocl-18 Power sensor HP 8461A SN: MY41092317 07-Oct-15 (in house check Oct-16) In house check: Oct-18 RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-16) In house check: Ocl-18 Network Analyzer HP 8753E SN: US37390585 18-Oct-01 (in house check Oct-16) In house check: Oct-17 Name Function Signatule Michael Weber Calibrated by: Laboratory Technician Approved by: Katja Pokovic Technical Manager Issued: November 11, 2016

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

Certificate No: D2600V2-1132_Nov16

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



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

Accreditation No.: SCS 0108

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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

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 1528-2013, "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
- 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) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) 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%.

Certificate No: D2600V2-1132_Nov16

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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	2600 MHz ± 1 MHz	

Head TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.6 ± 6 %	2.04 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	14.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	56.1 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 250 mW input power	6.38 W/kg

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.8 ± 6 %	2.20 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	13.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	53.9 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.2 W/kg ± 16.5 % (k=2)

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.6 Ω - 8.6 jΩ
Return Loss	- 20.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.0 Ω - 6.1 jΩ
Return Loss	- 20.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.154 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	October 12, 2016

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DASY5 Validation Report for Head TSL

Date: 10.11.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1132

Communication System: UID 0 - CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz; σ = 2.04 S/m; ϵ_r = 37.6; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.56, 7.56, 7.56); Calibrated: 15.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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

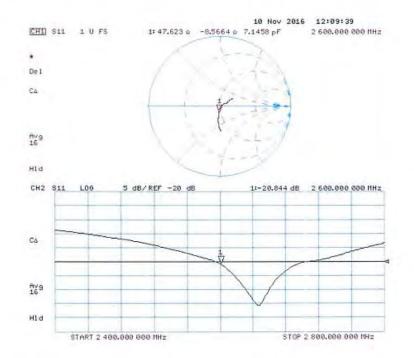
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 115.0 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 30.4 W/kg SAR(1 g) = 14.4 W/kg; SAR(10 g) = 6.38 W/kg Maximum value of SAR (measured) = 24.2 W/kg



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DASY5 Validation Report for Body TSL

Date: 10.11.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1132

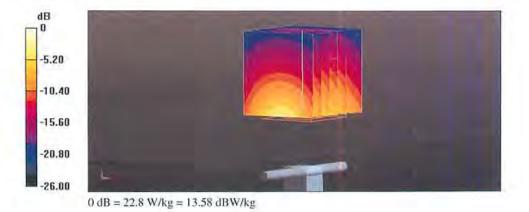
Communication System: UID 0 - CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz; $\sigma = 2.2$ S/m; $\epsilon_r = 50.8$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.48, 7.48, 7.48); Calibrated: 15.06,2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

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

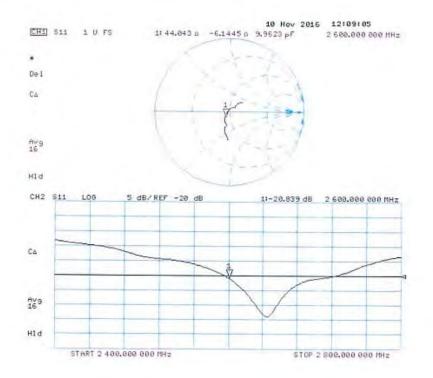
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 107.2 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 27.9 W/kg SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.1 W/kg Maximum value of SAR (measured) = 22.8 W/kg



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Impedance Measurement Plot for Body TSL



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