

ANNEX B – RELEVANT PAGES FROM CALIBRATION REPORTS

DAE4 Sn:546

 <p>In Collaboration with s p e a g CALIBRATION LABORATORY</p> <p>Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-6236633-2312 Fax: +86-10-62364633-2304 E-mail: sctt@ttcal.com.cn http://www.ttcal.com.cn</p> <p>Client : SRTC Certificate No: Z18-60400</p> <p>CALIBRATION CERTIFICATE</p> <p>Object DAE4 - SN: 546</p> <p>Calibration Procedure(s) FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAE)</p> <p>Calibration date: October 16, 2018</p> <p>This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility; environment temperature(22±0.5)°C and humidity<70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date(Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Process Calibrator 753</td> <td>1971018</td> <td>20-Jun-18 (CTTL, No.J1BX05034)</td> <td>June-19</td> </tr> </tbody> </table> <p>Calibrated by: Name: Yu Zongying Function: SAR Test Engineer Signature: </p> <p>Reviewed by: Name: Lin Hao Function: SAR Test Engineer Signature: </p> <p>Approved by: Name: Qi Dianyuan Function: SAR Project Leader Signature: </p> <p>Issued: October 17, 2018</p> <p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p> <p>Certificate No: Z18-60400 Page 1 of 3</p>	Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration	Process Calibrator 753	1971018	20-Jun-18 (CTTL, No.J1BX05034)	June-19	 <p>In Collaboration with s p e a g CALIBRATION LABORATORY</p> <p>Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-6236633-2312 Fax: +86-10-62364633-2304 E-mail: sctt@ttcal.com.cn http://www.ttcal.com.cn</p> <p>Glossary: DAE data acquisition electronics Connector angle information used in DASY system to align probe sensor X to the robot coordinate system.</p> <p>Methods Applied and Interpretation of Parameters:</p> <ul style="list-style-type: none"> • DC Voltage Measurement: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range. • Connector angle: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required. • The report provides only calibration results for DAE, it does not contain other performance test results. <p>Certificate No: Z18-60400 Page 2 of 3</p>
Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration						
Process Calibrator 753	1971018	20-Jun-18 (CTTL, No.J1BX05034)	June-19						

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ES3DV3 Sn:3127

CLIENT		CERTIFICATE																																													
Client	SRTC	Certificate No:	Z18-60398																																												
Object	ES3DV3 - SN:3127																																														
Calibration Procedure(s)	FF-Z11-004-01	Calibration Procedures for Dosimetric E-field Probes																																													
Calibration date:	November 02, 2018																																														
<p>This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility; environment temperature(22±2)°C and humidity<70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p>																																															
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Glossary:

- TSL:** tissue simulating liquid
- NCRM_{x,y,z}:** sensitivity in free space
- Conf:** confidence interval around NCRM_{x,y,z}
- DOP:** diode compression point
- OF:** over factor (1+N_{ULY}) of the RF signal
- A,B,C,D:** modulation dependent linearization parameters
- Polarization φ:** φ rotation around probe axis
- Polarization θ:** θ rotation around axis that is in the plane normal to probe axis (at measurement center), i.e. B=0 is normal to probe axis
- Connector Angle:** information used in DASY system to align probe sensor X to the root coordinate system
- Calibration is Performed According to the Following Standards:**
 - a) IEEE Std C95.1-2012, "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 62203-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body mounted devices used next to the ear (frequency range of 300 MHz to 3 GHz)", July 2012
 - c) IEC 62208-2, "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 2012
 - d) IEC 626664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
- Methods Applied and Interpretation of Parameters:**
 - NCRM_{x,y,z}: Assessed for E-field polarization (θ=0)@500MHz in TEM-cell (>1800MHz waveguide).
NCRM_{x,y,z} are only intermediate values, i.e., the uncertainties of NCRM_{x,y,z} does not effect the E'-field uncertainty inside TSL (see below ConvF).
 - NORMT_{x,y,z} = NCRM_{x,y,z}*frequency response (see Frequency Response Chart). This linear scaling is included in DASY4 software versions older than 4.2. The uncertainty of the frequency response is included in the assessed uncertainty of ConvF.
 - DCP_{x,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 amplitude.
 - Ax,y,z; Bx,y,z; Cx,y,z: Ax,y,z; Bx,y,z; Cx,y,z are numerical linearization parameters assessed based on the data of cover 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) transducers. These parameters are used to correct the measured values for variations on power measurements for f>800MHz. The same adaptions are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The same adaptions corresponding to NORMT_{x,y,z} ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency range of 300MHz to 1000MHz is used in DASY version 4.4 and higher which allows extending the validity from 500MHz to 1000MHz.
 - Spherical isotropy (ID deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
 - ConvF: The value of ConvF 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 NCRM_{x,y,z} (no uncertainty required).

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Probe ES3DV3

SN: 3127

Calibrated: November 02, 2018

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system)

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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3127

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μ V/Vm) ^a	1.27	1.26	1.21	±10.0%
DCP(mV) ^b	103.3	104.4	105.0	

Modulation Calibration Parameters

UID	Communication System Name	A dB	B dB/ μ V	C	D dB	VR mV	Unc ^c (k=2)
0	CW	X 0.0	0.0	1.0	0.00	285.6	±2.2%
		Y 0.0	0.0	1.0		287.9	
		Z 0.0	0.0	1.0		282.9	

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%.

^aThe uncertainty of Norm V/V is ±2% does not affect the E² field uncertainty inside TBL (see Page 5 and Page 6).
^bNumerical linearization parameter uncertainty not required.
^cUncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3127

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz] ^d	Relative Permittivity ^e	Conductivity [S/m] ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^h (mm)	Unc. (k=2)
750	41.9	0.89	6.34	6.34	6.34	0.40	1.35	±12.1%
835	41.5	0.90	6.18	6.18	6.18	0.35	1.58	±12.1%
1810	4.00	1.40	5.07	5.07	5.07	0.66	1.24	±12.1%
2000	4.00	1.40	4.96	4.96	4.96	0.70	1.20	±12.1%
2300	3.95	1.67	4.79	4.79	4.79	0.90	1.08	±12.1%
2450	3.92	1.80	4.66	4.66	4.66	0.90	1.08	±12.1%
2600	3.90	1.96	4.40	4.40	4.40	0.80	1.21	±12.1%

^d 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.

^e At frequency below 3 GHz, the validity of tissue parameters (c and d) 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 (c and d) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3127

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz] ^d	Relative Permittivity ^e	Conductivity [S/m] ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^h (mm)	Unc. (k=2)
750	55.5	0.98	6.33	6.33	6.33	0.40	1.40	±12.1%
835	55.2	0.97	6.13	6.13	6.13	0.37	1.62	±12.1%
1810	53.3	1.52	4.78	4.78	4.78	0.65	1.27	±12.1%
2000	53.3	1.52	4.80	4.80	4.80	0.67	1.27	±12.1%
2300	52.9	1.81	4.46	4.46	4.46	0.90	1.15	±12.1%
2450	52.7	1.06	4.31	4.31	4.31	0.70	1.28	±12.1%
2600	52.5	2.10	4.14	4.14	4.14	0.90	1.10	±12.1%

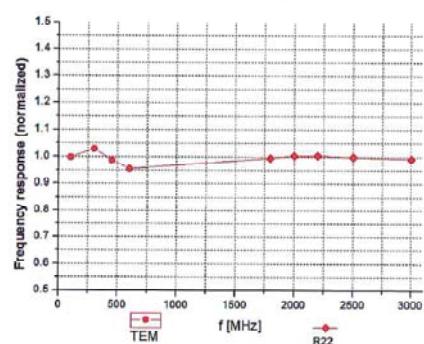
^d Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 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.

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Frequency Response of E-Field (TEM-Cell: Ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.4% (k=2)

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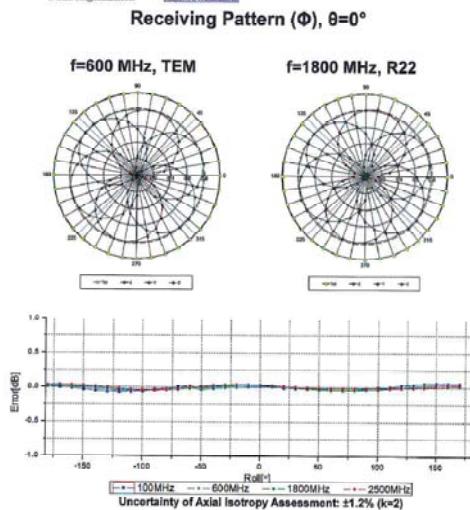
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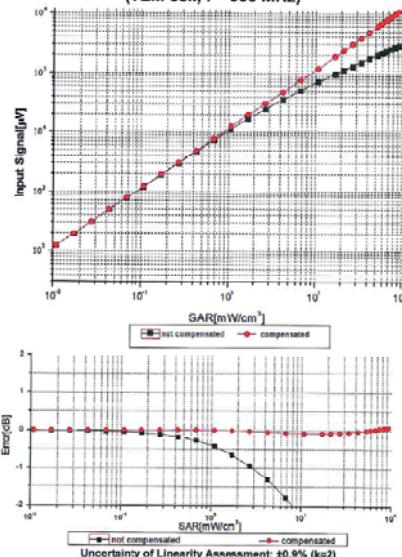
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Dynamic Range f(SAR_{head}) (TEM cell, $f = 900$ MHz)



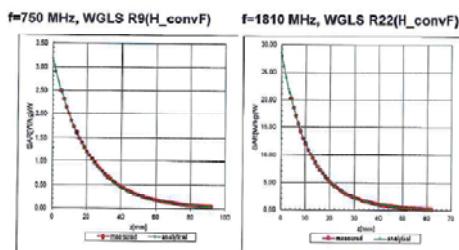
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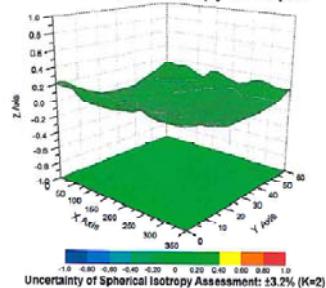
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Conversion Factor Assessment



Deviation from Isotropy in Liquid



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Appendix: Modulation Calibration Parameters

UID	Communication System Name	PAR	A	B	C	VR	Unc ^E
			dB	dB·μV	mV		
0	CW	0.00	X 0.0	0.0	1.0	282.3	$\pm 2.5\%$
			Y 0.0	0.0	1.0	280.9	
			Z 0.0	0.0	1.0	275.1	
10012	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	1.87	X 2.77	68.02	18.46	143.0	$\pm 1.8\%$
			Y 2.75	68.05	18.52	145.0	
			Z 2.71	67.79	18.25	142.3	
10100	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	5.67	X 6.13	66.4	18.97	141.9	$\pm 1.9\%$
			Y 6.15	66.49	19.06	144.2	
			Z 6.09	66.32	18.90	140.9	
10108	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	5.80	X 6.09	66.24	19.07	139.5	$\pm 1.9\%$
			Y 6.10	66.33	19.15	141.5	
			Z 6.05	66.19	19.05	138.0	
10154	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	5.75	X 5.81	65.85	18.93	136.1	$\pm 1.9\%$
			Y 5.82	65.92	19.01	137.8	
			Z 5.79	65.89	18.97	134.7	
10169	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	5.73	X 4.84	65.92	19.20	130.8	$\pm 1.9\%$
			Y 4.82	65.98	19.27	131.3	
			Z 4.80	66.00	19.29	129.1	
10175	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	5.72	X 4.88	66.14	19.40	131.6	$\pm 1.9\%$
			Y 4.83	66.08	19.33	130.9	
			Z 4.79	66.02	19.29	129.3	
10297	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	5.81	X 6.19	66.61	19.42	141.9	$\pm 1.9\%$
			Y 6.13	66.43	19.26	140.7	
			Z 6.14	66.52	19.33	139.6	

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D750V3 Sn:1101 (1/2)



Client SRTC

Certificate No: Z17-97134

CALIBRATION CERTIFICATE

Object	D750V3 - SN: 1101			
Calibration Procedure(s)	FF-211-003-01 Calibration Procedures for dipole validation kits			
Calibration date	September 13, 2017			
This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.				
All calibrations have been conducted in the closed laboratory facility; environment temperature(22±3)°C and humidity<70%.				
Calibration Equipment used (M&TE critical for calibration)				
Primary Standards	ID #	Cal Date/Calibrated by, Certificate No.) Scheduled Calibration		
Power Meter NRVID	102196	02-Mar-17 (CTTL, No.J17X01254) Mar-18		
Power sensor NRZ-S	100596	02-Mar-17 (CTTL, No.J17X01254) Mar-18		
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG, No EX3-T433_Sep16)		
DAE4	SN 1331	19-Jan-17(CTTL-SPEAG, No.Z17-97015) Jan-18		
Secondary Standards	ID #	Cal Date/Calibrated by, Certificate No.) Scheduled Calibration		
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X0286) Jan-18		
Network Analyzer E5071C	MY46111013	13-Jan-17 (CTTL, No.J17X00285) Jan-18		
Calibrated by:	Name	Function		
Zhao Jing	SAR Test Engineer			
Reviewed by:	Yu Zongying	SAR Test Engineer		
Approved by:	Qi Dianyuan	SAR Project Leader		
Issued: September 16, 2017				
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Glossary:

TSL	tissue simulating liquid
ComF	sensitivity in TSL / NORMxyz
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, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- 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/S 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 reflection coefficient. 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	52.10.1446
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	16 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	0.88 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.5 ± 6 %	0.88 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	2.05 mW/g
SAR for nominal Head TSL parameters	normalized to 1W	8.26 mW/g ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.34 mW/g
SAR for nominal Head TSL parameters	normalized to 1W	5.39 mW/g ± 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied:

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.98 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.4 ± 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	2.15 mW/g
SAR for nominal Body TSL parameters	normalized to 1W	8.49 mW/g ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.42 mW/g
SAR for nominal Body TSL parameters	normalized to 1W	5.73 mW/g ± 18.7 % (k=2)

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.9Ω ± 0.24Ω
Return Loss	-28.4dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	52.0Ω ± 2.22Ω
Return Loss	-30.6dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.136 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. This is explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The 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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D750V3 Sn:1101 (2/2)



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E-mail: ctll@chinatele.com http://www.chinatele.cn

DASYS Validation Report for Head TSL

Date: 09.13.2017

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1101

Communication System: UUD 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used: $\epsilon = 750 \text{ MHz}$; $\sigma = 0.879 \text{ S/m}$; $\epsilon_r = 41.54$; $\rho = 1000 \text{ kg/m}^3$

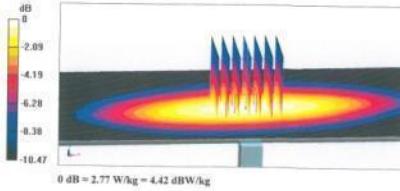
Phantom section: Left Section

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

DASYS Configuration:

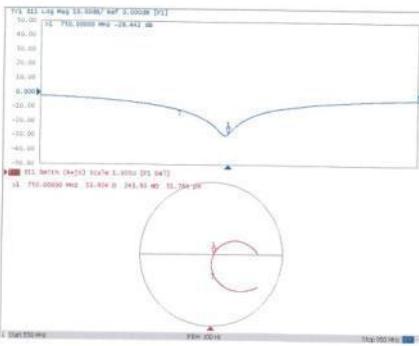
- Probe: EX3DV4 - SN7433; ConvF(0.01, 10.01, 10.01); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASYS2, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 53.10 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 3.17 W/kg
SAR(1 g) = 2.08 W/kg; SAR(10 g) = 1.34 W/kg
Maximum value of SAR (measured) = 2.77 W/kg



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Impedance Measurement Plot for Head TSL



D835V2 Sn:4d023

<p>CALIBRATION CERTIFICATE</p> <p>Object: D835V2 - SN: 4d023</p> <p>Calibration Procedure(s): FF-Z11-003-01 Calibration Procedures for dipole validation kits</p> <p>Calibration date: September 13, 2017</p> <p>This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility environment temperature(22±3)°C and humidity<70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date(Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power Meter NRV-D</td> <td>102196</td> <td>02-Mar-17 (CCTL No J17X01254)</td> <td>Mar-18</td> </tr> <tr> <td>Power sensor NRV-ZS</td> <td>100596</td> <td>02-Mar-17 (CCTL No J17X01254)</td> <td>Mar-18</td> </tr> <tr> <td>Reference Probe EX307V4</td> <td>SN 433</td> <td>26-Sep-16(SPEAG No EX3-7433_Sep16)</td> <td>Sep-17</td> </tr> <tr> <td>DAE4</td> <td>SN 1331</td> <td>19-Jan-17(CCTL-SPEAG No Z17-9715)</td> <td>Jan-18</td> </tr> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Cal Date(Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> <tr> <td>Signal Generator E4438C</td> <td>MY49071430</td> <td>13-Jan-17 (CCTL No J17X00286)</td> <td>Jan-18</td> </tr> <tr> <td>Network Analyzer E5071C</td> <td>MY46110673</td> <td>13-Jan-17 (CCTL No J17X00285)</td> <td>Jan-18</td> </tr> </tbody> </table> <p>Calibrated by: Zhao Jing SAR Test Engineer</p> <p>Reviewed by: Yu Zongying SAR Test Engineer</p> <p>Approved by: Qi Dianyuan SAR Project Leader</p> <p>Issued: September 18, 2017</p> <p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p>	Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration	Power Meter NRV-D	102196	02-Mar-17 (CCTL No J17X01254)	Mar-18	Power sensor NRV-ZS	100596	02-Mar-17 (CCTL No J17X01254)	Mar-18	Reference Probe EX307V4	SN 433	26-Sep-16(SPEAG No EX3-7433_Sep16)	Sep-17	DAE4	SN 1331	19-Jan-17(CCTL-SPEAG No Z17-9715)	Jan-18	Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration	Signal Generator E4438C	MY49071430	13-Jan-17 (CCTL No J17X00286)	Jan-18	Network Analyzer E5071C	MY46110673	13-Jan-17 (CCTL No J17X00285)	Jan-18	<p>CALIBRATION CERTIFICATE</p> <p>In Collaboration with </p> <p>Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62350633-2079 Fax: +86-10-62350633-2504 E-mail: ctt@chinatl.com http://www.chinatl.com</p> <p>TSL: issue simulating liquid ConvF: sensitivity in TSL / NORRx.y.z N/A: not applicable or not measured</p> <p>Calibration is Performed According to the Following Standards:</p> <ol style="list-style-type: none"> IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Specific-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques", June 2013 IEC 62209-1, "Measurement procedure for the specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 1: Device used next to the ear (Frequency range of 30MHz to 6GHz)", March 2010 IEC 62209-4, "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 KDBB65664, SAR Measurement Requirements for 100 MHz to 6 GHz <p>Additional Documentation:</p> <ol style="list-style-type: none"> DASY4/5 System Handbook <p>Methods Applied and Interpretation of Parameters:</p> <ul style="list-style-type: none"> Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in this report are valid at the frequency indicated. Antenna Parameters with TSL: The dipole is mounted with the spacing to point 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 need 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. 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Certificate No: Z17-97135

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<p>CALIBRATION CERTIFICATE</p> <p>In Collaboration with </p> <p>Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62350633-2079 Fax: +86-10-62350633-2504 E-mail: ctt@chinatl.com http://www.chinatl.com</p> <p>Measurement Conditions DASY system configuration, as far as not given on page 1.</p> <table border="1"> <thead> <tr> <th>DASY Version</th> <th>DASY2</th> <th>52.10.0.1446</th> </tr> </thead> <tbody> <tr> <td>Extrapolation</td> <td>Advanced Extrapolation</td> <td></td> </tr> <tr> <td>Phantom</td> <td>Triple Flat Phantom 5.1C</td> <td></td> </tr> <tr> <td>Distance Dipole Center - TSL</td> <td>15 mm</td> <td>with Spacer</td> </tr> <tr> <td>Zoom Scan Resolution</td> <td>dx, dy, dz = 5 mm</td> <td></td> </tr> <tr> <td>Frequency</td> <td>835 MHz ± 1 MHz</td> <td></td> </tr> </tbody> </table> <p>Head TSL parameters The following parameters and calculations were applied.</p> <table border="1"> <thead> <tr> <th></th> <th>Temperature</th> <th>Permittivity</th> <th>Conductivity</th> </tr> </thead> <tbody> <tr> <td>Nominal Head TSL parameters</td> <td>22.0 °C</td> <td>41.5</td> <td>0.90 mho/m</td> </tr> <tr> <td>Measured Head TSL parameters</td> <td>(22.0 ± 0.2) °C</td> <td>41.3 ± 6 %</td> <td>0.90 mho/m ± 6 %</td> </tr> <tr> <td>Head TSL temperature change during test</td> <td><1.0 °C</td> <td>----</td> <td>----</td> </tr> </tbody> </table> <p>SAR result with Head TSL SAR averaged over 1 cm³ (1 g) of Head TSL</p> <table border="1"> <thead> <tr> <th>Condition</th> <th></th> </tr> </thead> <tbody> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td>2.35 mW / g</td> </tr> <tr> <td>SAR for nominal Head TSL parameters</td> <td>normalized to 1W</td> <td>9.37 mW / g ± 18.8 % (k=2)</td> </tr> </tbody> </table> <p>SAR averaged over 10 cm³ (10 g) of Head TSL</p> <table border="1"> <thead> <tr> <th>Condition</th> <th></th> </tr> </thead> <tbody> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td>1.52 mW / g</td> </tr> <tr> <td>SAR for nominal Head TSL parameters</td> <td>normalized to 1W</td> <td>6.08 mW / g ± 18.7 % (k=2)</td> </tr> </tbody> </table> <p>Body TSL parameters The following parameters and calculations were applied.</p> <table border="1"> <thead> <tr> <th></th> <th>Temperature</th> <th>Permittivity</th> <th>Conductivity</th> </tr> </thead> <tbody> <tr> <td>Nominal Body TSL parameters</td> <td>22.0 °C</td> <td>55.2</td> <td>0.97 mho/m</td> </tr> <tr> <td>Measured Body TSL parameters</td> <td>(22.0 ± 0.2) °C</td> <td>55.7 ± 6 %</td> <td>0.96 mho/m ± 6 %</td> </tr> <tr> <td>Body TSL temperature change during test</td> <td><1.0 °C</td> <td>----</td> <td>----</td> </tr> </tbody> </table> <p>SAR result with Body TSL SAR averaged over 1 cm³ (1 g) of Body TSL</p> <table border="1"> <thead> <tr> <th>Condition</th> <th></th> </tr> </thead> <tbody> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td>2.34 mW / g</td> </tr> <tr> <td>SAR for nominal Body TSL parameters</td> <td>normalized to 1W</td> <td>9.47 mW / g ± 18.8 % (k=2)</td> </tr> </tbody> </table> <p>SAR averaged over 10 cm³ (10 g) of Body TSL</p> <table border="1"> <thead> <tr> <th>Condition</th> <th></th> </tr> </thead> <tbody> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td>1.53 mW / g</td> </tr> <tr> <td>SAR for nominal Body TSL parameters</td> <td>normalized to 1W</td> <td>6.17 mW / g ± 18.7 % (k=2)</td> </tr> </tbody> </table>	DASY Version	DASY2	52.10.0.1446	Extrapolation	Advanced Extrapolation		Phantom	Triple Flat Phantom 5.1C		Distance Dipole Center - 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Electrical Delay (one direction)	1.495 ns																																																																																														
Manufactured by	SPEAG																																																																																														

Certificate No: Z17-97135

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D835V2 Sn:4d023

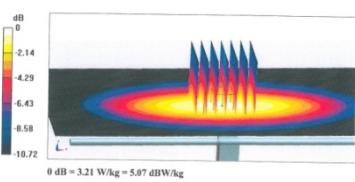


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DASY5 Validation Report for Head TSL
Test Laboratory: CTTL, Beijing, China
DUT: Dipole 835 MHz; Type: D835V2 - SN: 4d023
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium parameters used: $\epsilon = 835 \text{ MHz}$; $\sigma = 0.903 \text{ S/m}$; $\epsilon_r = 41.34$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Left Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI CG.63.19-2007)

- Probe: EX3DV4 - SN7433; ConvF(9.82, 9.82, 9.82); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.28V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.66 W/kg
 $\text{SAR}(1 \text{ g}) = 2.35 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 1.52 \text{ W/kg}$
Maximum value of SAR (measured) = 3.21 W/kg



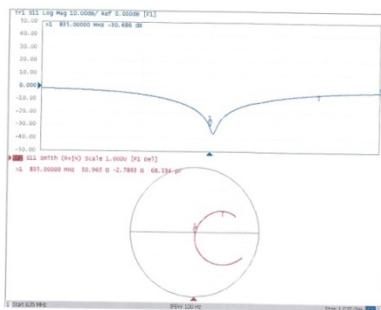
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Impedance Measurement Plot for Head TSL



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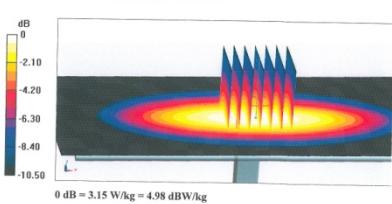


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DASY5 Validation Report for Body TSL
Test Laboratory: CTTL, Beijing, China
DUT: Dipole 835 MHz; Type: D835V2 - SN: 4d023
Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium parameters used: $\epsilon = 835 \text{ MHz}$; $\sigma = 0.958 \text{ S/m}$; $\epsilon_r = 55.68$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI CG.63.19-2007)

- Probe: EX3DV4 - SN7433; ConvF(9.5, 9.5, 9.5); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.17 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.57 W/kg
 $\text{SAR}(1 \text{ g}) = 2.34 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 1.53 \text{ W/kg}$
Maximum value of SAR (measured) = 3.15 W/kg



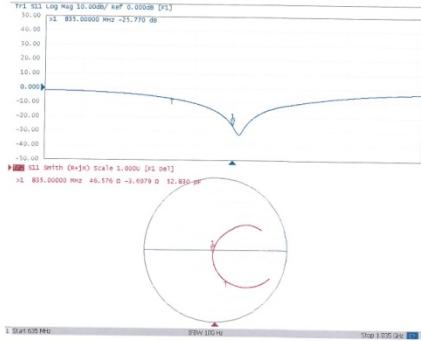
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Impedance Measurement Plot for Body TSL



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D1800V2 Sn:2d084																																																																																																			
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The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date(Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power Meter NRP2</td> <td>102196</td> <td>02-Mar-17 (CTTL, No.J17X01254)</td> <td>Mar-18</td> </tr> <tr> <td>Power sensor NRP-Z91</td> <td>100595</td> <td>02-Mar-17 (CTTL, No.J17X01254)</td> <td>Mar-18</td> </tr> <tr> <td>Reference Probe EX3DV4</td> <td>SN 7433</td> <td>26-Sep-16(SPEAG No.EX3-7433, Sep16)</td> <td>Sep-17</td> </tr> <tr> <td>DAE4</td> <td>SN 1331</td> <td>19-Jan-17(CTTL-SPEAG No.Z17-97015)</td> <td>Jan-18</td> </tr> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Cal Date(Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> <tr> <td>Signal Generator E4438C</td> <td>MY49071430</td> <td>13-Jan-17 (CTTL, No.J17X00286)</td> <td>Jan-18</td> </tr> <tr> <td>Network Analyzer E5071C</td> <td>MY46110673</td> <td>13-Jan-17 (CTTL, No.J17X00285)</td> <td>Jan-18</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Calibrated by:</th> <th>Name</th> <th>Function</th> <th>Signature</th> </tr> </thead> <tbody> <tr> <td>Zhao Jing</td> <td>SAR Test Engineer</td> <td></td> </tr> <tr> <td>Reviewed by:</td> <td>Yu Zongying</td> <td>SAR Test Engineer</td> <td></td> </tr> <tr> <td>Approved by:</td> <td>Qi Dianyuan</td> <td>SAR Project Leader</td> <td></td> </tr> </tbody> </table> <p>Issued: September 18, 2017 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p> <p>Certificate No: Z17-97138 Page 1 of 8</p>	Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration	Power Meter NRP2	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18	Power sensor NRP-Z91	100595	02-Mar-17 (CTTL, No.J17X01254)	Mar-18	Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG No.EX3-7433, Sep16)	Sep-17	DAE4	SN 1331	19-Jan-17(CTTL-SPEAG No.Z17-97015)	Jan-18	Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration	Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18	Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18	Calibrated by:	Name	Function	Signature	Zhao Jing	SAR Test Engineer		Reviewed by:	Yu Zongying	SAR Test Engineer		Approved by:	Qi Dianyuan	SAR Project Leader		 <p>Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ctli@chinatl.com http://www.chinatl.cn</p> <p>Glossary: TSL tissue simulating liquid ConvF sensitivity in TSL / NORMx,y,z N/A not applicable or not measured</p> <p>Calibration is Performed According to the Following Standards:</p> <ol style="list-style-type: none"> IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013 IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005 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 KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz <p>Additional Documentation: e) DASY4/5 System Handbook</p> <p>Methods Applied and Interpretation of Parameters:</p> <ul style="list-style-type: none"> Measurement Conditions: Further details are available from the Validation Report at the end of the certificates. All figures stated in the certificates are valid at the frequency indicated. Antenna Parameters with TSL: The dipole is mounted with the spacing 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. Uncertainty: Uncertainty of the SAR measured. 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. <p>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%.</p> <p>Certificate No: Z17-97138 Page 2 of 8</p>																																																			
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TSL	10 mm	with Spacer	Zoom Scan Resolution	dx, dy, dz = 5 mm		Frequency	1800 MHz ± 1 MHz			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	40.4 ± 6 %	1.42 mho/m ± 6 %	Head TSL temperature change during test	<1.0 °C	----	----	SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		SAR measured	250 mW input power	9.79 mW / g	SAR for nominal Head TSL parameters	normalized to 1W	38.9 mW / g ± 18.8 % (k=2)	SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition		SAR measured	250 mW input power	5.12 mW / g	SAR for nominal Head TSL parameters	normalized to 1W	20.4 mW / g ± 18.7 % (k=2)		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	53.8 ± 6 %	1.50 mho/m ± 6 %	Body TSL temperature change during test	<1.0 °C	----	----	SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition		SAR measured	250 mW input power	9.94 mW / g	SAR for nominal Body TSL parameters	normalized to 1W	39.7 mW / g ± 18.8 % (k=2)	SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition		SAR measured	250 mW input power	5.18 mW / g	SAR for nominal Body TSL parameters	normalized to 1W	20.8 mW / g ± 18.7 % (k=2)	 <p>Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ctli@chinatl.com http://www.chinatl.cn</p> <p>Appendix (Additional assessments outside the scope of CNAS L0570)</p> <p>Antenna Parameters with Head TSL</p> <table border="1"> <thead> <tr> <th>Impedance, transformed to feed point</th> <th>49.30- 1.55Ω</th> </tr> </thead> <tbody> <tr> <td>Return Loss</td> <td>- 35 dB</td> </tr> </tbody> </table> <p>Antenna Parameters with Body TSL</p> <table border="1"> <thead> <tr> <th>Impedance, transformed to feed point</th> <th>46.00- 1.32Ω</th> </tr> </thead> <tbody> <tr> <td>Return Loss</td> <td>- 27 dB</td> </tr> </tbody> </table> <p>General Antenna Parameters and Design</p> <table border="1"> <thead> <tr> <th>Electrical Delay (one direction)</th> <th>1.318 ns</th> </tr> </thead> </table> <p>After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.</p> <p>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 the addition of the end caps, as long as 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.</p> <p>Additional EUT Data</p> <table border="1"> <thead> <tr> <th>Manufactured by</th> <th>SPEAG</th> </tr> </thead> </table> <p>Certificate No: Z17-97138 Page 4 of 8</p>	Impedance, transformed to feed point	49.30- 1.55Ω	Return Loss	- 35 dB	Impedance, transformed to feed point	46.00- 1.32Ω	Return Loss	- 27 dB	Electrical Delay (one direction)	1.318 ns	Manufactured by	SPEAG
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D1800V2 Sn:2d084



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DASY5 Validation Report for Head TSL
Test Laboratory: CTII, Beijing, China Date: 09.15.2017

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d084

Communication System: UID 0, CW; Frequency: 1800 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 1800$ MHz; $\sigma = 1.423$ S/m; $\epsilon_r = 40.37$; $\rho = 1000$ kg/m³

Phantom section: Left Section

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

DASY5 Configuration:

- Probe: EX3DVA - SN7433; ConvF(7.97, 7.97, 7.97); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

System Performance Check/Zoom Scan (7x7) (7x7)Cube 0: Measurement grid:

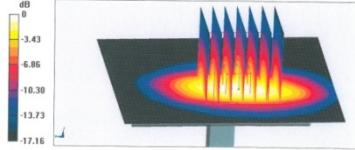
dx<5mm, dy=5mm, dz=5mm

Reference Value = 93.90 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 18.7 W/kg

SAR(1 g) = 9.79 W/kg; SAR(10 g) = 5.12 W/kg

Maximum value of SAR (measured) = 15.5 W/kg



0 dB = 15.5 W/kg = 11.90 dBW/kg

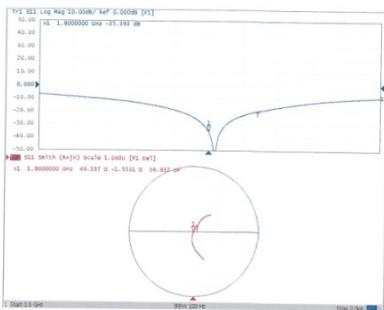
Certificate No: Z17-97138

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Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 09.14.2017

Test Laboratory: CTII, Beijing, China

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d1084

Communication System: UID 0, CW; Frequency: 1800 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 1800$ MHz; $\sigma = 1.503$ S/m; $\epsilon_r = 53.79$; $\rho = 1000$ kg/m³

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: EX3DVA - SN7433; ConvF(7.75, 7.75, 7.75); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7413)

System Performance Check/Zoom Scan (7x7) (7x7)Cube 0: Measurement grid:

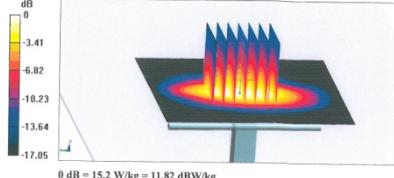
dx<5mm, dy=5mm, dz=5mm

Reference Value = 97.57 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 18.0 W/kg

SAR(1 g) = 9.84 W/kg; SAR(10 g) = 5.18 W/kg

Maximum value of SAR (measured) = 15.2 W/kg



0 dB = 15.2 W/kg = 11.82 dBW/kg

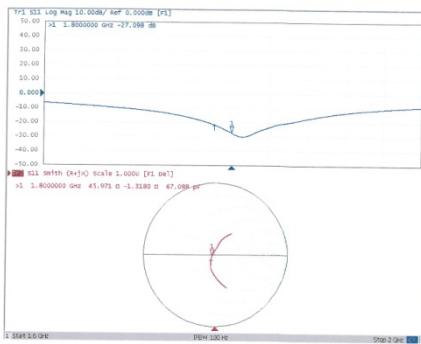
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Impedance Measurement Plot for Body TSL



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D2000V2 Sn:1009



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CALIBRATION CERTIFICATE

Object D2000V2 - SN: 1009

Calibration Procedure(s) FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date: February 1, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100508	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 7464	12-Sep-17(SPEAG No.EX3-1464_Sep17)	Sep-18
DAE4	SN 1525	02-Oct-17(SPEAG No.DAE4-1525_Oct17)	Oct-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4439C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
Network Analyzer E5071C	MY48110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

Calibrated by:	Name	Function	Signature
Zhao Jing	SAR Test Engineer		
Lin Hao	SAR Test Engineer		
Qi Dianyuan	SAR Project Leader		

Issued: February 4, 2018

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Glossary:

TSL tissue simulating liquid
ConvF sensitivity in TSL / $\text{NRM}_{x,y,z}$
N/A not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1526-2013, "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, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- 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) KDB655664, 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 connected to a standard SMA connector. 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 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	DASY02	52.10.0.1446
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	2000 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	38.9 ± 6 %	1.42 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	10.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.3 mW / g ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.18 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.5 mW / g ± 18.7 % (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	51.8 ± 6 %	1.56 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	10.3 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.3 mW / g ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.18 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.4 mW / g ± 18.7 % (k=2)

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.8Q- 2.08jΩ
Return Loss	-33.6dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.3Q- 1.63jΩ
Return Loss	-27.6dB

General Antenna Parameters and Design

Electrical Delay (one director)	1.047 ns
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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 with the correct position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change in antenna design and 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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D2000V2 Sn:1009



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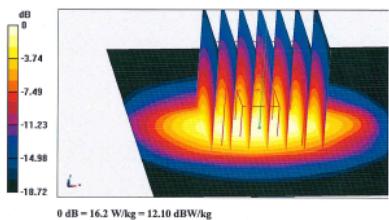
DASYS Validation Report for Head TSL Date: 02/01/2018

Test Laboratory: TTLL, Beijing, China
DUT: Dipole 2000 MHz; Type: D2000V2; Serial: D2000V2 - SN: 1009
Communication System: UID 0, CW; Frequency: 2000 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2000$ MHz; $\epsilon_r = 1.416$ Si/m; $\sigma = 38.89$; $\rho = 1000$ kg/m³
Phantom section: Left Section
Measurement Standard: DASY3 (IEEE/IEC/ANSI C63.19-2009)

DASYS Configuration:

- Probe: EX3DV4 - SN7464; ConvFi(8.39, 8.39, 8.39); Calibrated: 9/12/2017,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DA64 Sn1525; Calibrated: 10/2/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.98 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 19.7 W/kg
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.17 W/kg
Maximum value of SAR (measured) = 16.2 W/kg



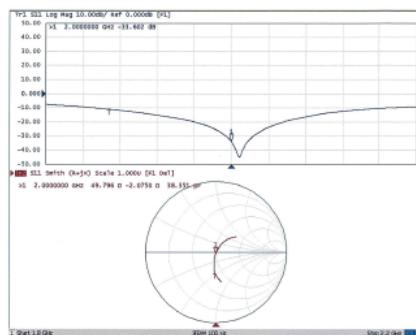
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Impedance Measurement Plot for Head TSL



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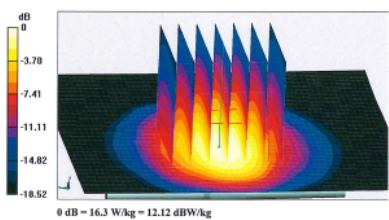
DASYS Validation Report for Body TSL Date: 02/01/2018

Test Laboratory: TTLL, Beijing, China
DUT: Dipole 2000 MHz; Type: D2000V2; Serial: D2000V2 - SN: 1009
Communication System: UID 0, CW; Frequency: 2000 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 2000$ MHz; $\epsilon_r = 1.564$ Si/m; $\sigma = 51.83$; $\rho = 1000$ kg/m³
Phantom section: Center Section
Measurement Standard: DASY3 (IEEE/IEC/ANSI C63.19-2007)

DASYS Configuration:

- Probe: EX3DV4 - SN7464; ConvFi(8.24, 8.24, 8.24); Calibrated: 9/12/2017,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DA64 Sn1525; Calibrated: 10/2/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.84 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 19.7 W/kg
SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.18 W/kg
Maximum value of SAR (measured) = 16.3 W/kg



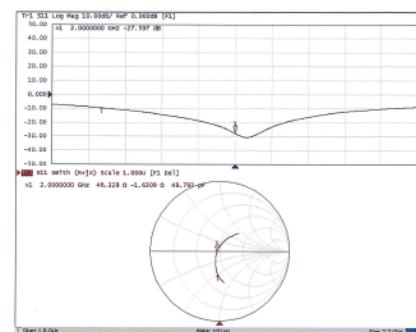
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Impedance Measurement Plot for Body TSL



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D2450V2 Sn:738

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The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date(Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power Meter NRV/D</td> <td>102196</td> <td>02-Mar-17 (CTTL, No.J17X01254)</td> <td>Mar-18</td> </tr> <tr> <td>Power sensor NRV/Z5</td> <td>100596</td> <td>02-Mar-17 (CTTL, No.J17X01254)</td> <td>Mar-18</td> </tr> <tr> <td>Reference Probe EX3DV4</td> <td>SN 7433</td> <td>26-Sep-16(SPEAG No EX3-7433_Sep16)</td> <td>Sep-17</td> </tr> <tr> <td>DAE4</td> <td>SN 1331</td> <td>19-Jan-17(CTTL-SPEAG No.Z17-97015)</td> <td>Jan-18</td> </tr> <tr> <td>Secondary Standards</td> <td>ID #</td> <td>Cal Date(Calibrated by, Certificate No.)</td> <td>Scheduled Calibration</td> </tr> <tr> <td>Signal Generator E4438C</td> <td>MY49071430</td> <td>13-Jan-17 (CTTL, No.J17X00286)</td> <td>Jan-18</td> </tr> <tr> <td>Network Analyzer E5071C</td> <td>MY46110673</td> <td>13-Jan-17 (CTTL, No.J17X00285)</td> <td>Jan-18</td> </tr> </tbody> </table> <p>Calibrated by: Name Zhao Jing Function SAR Test Engineer Signature </p> <p>Reviewed by: Yu Zongying SAR Test Engineer </p> <p>Approved by: Qi Dianyuan SAR Project Leader </p> <p>Issued: September 21, 2017</p> <p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p> <p>Certificate No: Z17-97140 Page 1 of 8</p> </div>	Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration	Power Meter NRV/D	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18	Power sensor NRV/Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18	Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG No EX3-7433_Sep16)	Sep-17	DAE4	SN 1331	19-Jan-17(CTTL-SPEAG No.Z17-97015)	Jan-18	Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration	Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18	Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18	<div style="text-align: center;">  <p>In Collaboration with s p e a g CALIBRATION LABORATORY</p> <p>Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ctfl@chinattl.com http://www.chinattl.cn</p> <p>Glossary:</p> <ul style="list-style-type: none"> TSL tissue simulating liquid ConvF sensitivity in TSL / NORMX,y,z N/A not applicable or not measured <p>Calibration is Performed According to the Following Standards:</p> <ol style="list-style-type: none"> IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013 IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016 IEC 62209-3, "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 KDB885064, SAR Measurement Requirements for 100 MHz to 6 GHz <p>Additional Documentation:</p> <p>e) DASY4/5 System Handbook</p> <p>Methods Applied and Interpretation of Parameters:</p> <ul style="list-style-type: none"> • Measurement Conditions: Further details are available from the Validation Report at the end of the certificates. All figures stated in the certificate are valid at the frequency indicated. • Antenna Parameters with TSL: The dipole is mounted with the spacing 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: Time 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. <p>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%.</p> <p>Certificate No: Z17-97140 Page 2 of 8</p> </div>																																																						
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<div style="text-align: center;">  <p>In Collaboration with s p e a g CALIBRATION LABORATORY</p> <p>Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ctfl@chinattl.com http://www.chinattl.cn</p> <p>Measurement Conditions DASY system configuration, as far as not given on page 1.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>DASY Version</th> <th>DASY52</th> <th>52.10.0.1446</th> </tr> </thead> <tbody> <tr> <td>Extrapolation</td> <td>Advanced Extrapolation</td> <td></td> </tr> <tr> <td>Phantom</td> <td>Triple Flat Phantom 5.1C</td> <td></td> </tr> <tr> <td>Distance Dipole Center - TSL</td> <td>10 mm</td> <td>with Spacer</td> </tr> <tr> <td>Zoom Scan Resolution</td> <td>dx, dy, dz = 5 mm</td> <td></td> </tr> <tr> <td>Frequency</td> <td>2450 MHz ± 1 MHz</td> <td></td> </tr> </tbody> </table> <p>Head TSL parameters The following parameters and calculations were applied</p> <table border="1" style="width: 100%; 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D2450V2 Sn:738



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DASYS Validation Report for Head TSL

Date: 09.18.2017

Test Laboratory: CTTI, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 738

Communication System: UUD 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: $\epsilon' = 2450 \text{ MHz}$; $\sigma = 1.788 \text{ S/m}$; $\epsilon_r = 38.67$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

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

DASYS Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.45, 7.45, 7.45); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASYS2, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

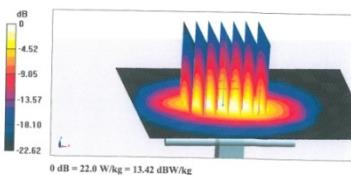
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.1 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.1 W/kg

Maximum value of SAR (measured) = 22.0 W/kg



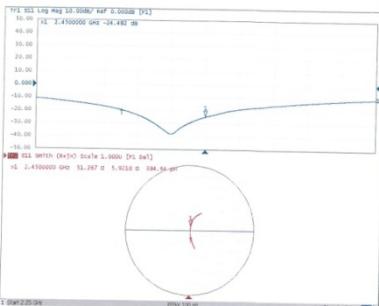
Certificate No: Z17-97140

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Impedance Measurement Plot for Head TSL



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DASYS Validation Report for Body TSL

Date: 09.18.2017

Test Laboratory: CTTI, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 738

Communication System: UUD 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: $\epsilon' = 2450 \text{ MHz}$; $\sigma = 1.983 \text{ S/m}$; $\epsilon_r = 52.51$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Center Section

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

DASYS Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.46, 7.46, 7.46); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASYS2, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

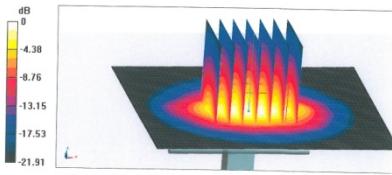
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.41 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.1 W/kg

Maximum value of SAR (measured) = 22.3 W/kg



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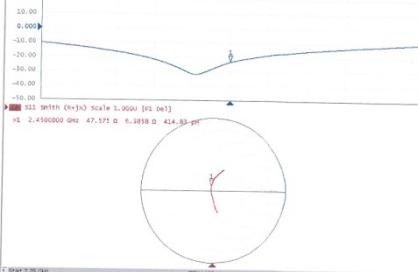
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Impedance Measurement Plot for Body TSL

YR1.831 Log Mag 10.00dB/ Ref 0.000dB [Y1]
X1: 2.4160000 GHz 32.116 dB

Y1: 51.267 Ω 51.938 ± 384.56-jΩ



Certificate No: Z17-97140

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-----End of the test report-----