

ANNEX B - RELEVANT PAGES FROM CALIBRATION REPORTS

DAE4 Sn:546

Client : SRTC		Certificate No: Z18-60400									
 											
CALIBRATION CERTIFICATE											
Object	DAE4 - SN: 546										
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAE)										
Calibration date:	October 15, 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(23±3)°C and humidity<70%. Calibration Equipment used (M&TE critical for calibration) <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>Process Calibrator 753</td> <td>1971018</td> <td>20-Jun-18 (CTTL, No.J18X05034)</td> <td>June-19</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration	Process Calibrator 753	1971018	20-Jun-18 (CTTL, No.J18X05034)	June-19
Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration								
Process Calibrator 753	1971018	20-Jun-18 (CTTL, No.J18X05034)	June-19								
Calibrated by:	Name	Function	Signature								
	Yu Zongying	SAR Test Engineer									
Reviewed by:	Lin Hao	SAR Test Engineer									
Approved by:	Qi Diaryuan	SAR Project Leader									
Issued: October 17, 2018 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.											
Certificate No: Z18-60400		Page 1 of 3									

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Glossary: DAE: data acquisition electronics Connector angle: information used in DASY system to align probe sensor X to the robot coordinate system.	
Methods Applied and Interpretation of Parameters: • DC Voltage Measurement: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range. • Connector angle: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required. • The report provide only calibration results for DAE, it does not contain other performance test results.	
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DC Voltage Measurement AD - Converter Resolution nominal High Range: 1LSB = 8.1uV, full range = -100...+300 mV Low Range: 1LSB = 81uV, full range = -1...+3mV DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec													
Calibration Factors	<table border="1"> <thead> <tr> <th></th> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>High Range</td> <td>405.306 ± 0.15% (k=2)</td> <td>404.059 ± 0.15% (k=2)</td> <td>404.180 ± 0.15% (k=2)</td> </tr> <tr> <td>Low Range</td> <td>3.98993 ± 0.7% (k=2)</td> <td>3.95876 ± 0.7% (k=2)</td> <td>3.98021 ± 0.7% (k=2)</td> </tr> </tbody> </table>		X	Y	Z	High Range	405.306 ± 0.15% (k=2)	404.059 ± 0.15% (k=2)	404.180 ± 0.15% (k=2)	Low Range	3.98993 ± 0.7% (k=2)	3.95876 ± 0.7% (k=2)	3.98021 ± 0.7% (k=2)
	X	Y	Z										
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Connector Angle to be used in DASY system													
	238° ± 1°												
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ES3DV3 Sn:3127

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Client: **SRTC** Certificate No: **Z18-60398**

CALIBRATION CERTIFICATE

Object: **ES3DV3 - SN3127**

Calibration Procedure(s): **FF-Z11-004-01**
Calibration Procedures for Dosimetric E-field Probes

Calibration date: **November 02, 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(23±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 NRP2	101919	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z01	101547	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z01	101548	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Reference10dBAttenuator	18N50W-10dB	09-Feb-18(CTTL, No.J18X01133)	Feb-20
Reference20dBAttenuator	18N50W-20dB	09-Feb-18(CTTL, No.J18X01133)	Feb-20
Reference Probe EX30V4	SN 3846	25-Jan-18(SPEAG, No.EK3-3846_Jan18)	Jan-19
DAE4	SN 777	15-Dec-17(SPEAG, No.DAE4-777_Dec17)	Dec-18

Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	21-Jun-18 (CTTL, No.J18X05033)	Jun-19
Network Analyzer ES071C	MY46110673	14-Jan-18 (CTTL, No.J18X00561)	Jan-19

Calibrated by: **Yu Zongying** SAR Test Engineer

Reviewed by: **Lin Hao** SAR Test Engineer

Approved by: **Qi Dianyan** SAR Project Leader

Issued: November 04, 2018

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Glossary:

TSL: tissue simulating liquid
NORM_{x,y,z}: sensitivity in free space
ConvF: sensitivity in TSL / NORM_{x,y,z}
DCP: diode compression point
CF: crest factor (1/duty_cycle) of the RF signal
A,B,C,D: modulation dependent linearization parameters
Polarization Φ : Φ rotation around probe axis
Polarization θ : θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i
 $\theta=0$ 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, "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 6 GHz)", July 2016
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) K28 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}: Assessed for E-field polarization $\theta=0$ (1500MHz in TEM-cell; 1-1800MHz waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not effect the E^2 field uncertainty inside TSL (see below ConvF).
- NORM_{x,y,z} = NORM_{x,y,z} frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- 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 characteristics.
- A_{x,y,z}, B_{x,y,z}, C_{x,y,z}, V_{0x,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. V₀ 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 1500MHz) and inside waveguide using analytical field distributions based on power measurements for 1-600MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} ConvF whereas 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 NORM_x (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!)

Certificate No: Z18-60398

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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(pV/(V/m)) ^a	1.27	1.25	1.21	±10.0%
DCP(mV) ^b	103.3	104.4	105.0	

Modulation Calibration Parameters

UID	Communication System Name	A dB	B dBμV	C	D dB	VR mV	Unc ^c
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%.

^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.
^c Uncertainty 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: ES3DV3 - SN: 3127

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz] ^c	Relative Permittivity ^d	Conductivity (S/m) ^e	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^h (mm)	Unc ⁱ (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	40.0	1.40	5.07	5.07	5.07	0.86	1.24	±12.1%
2000	40.0	1.40	4.96	4.96	4.96	0.70	1.20	±12.1%
2300	39.5	1.67	4.79	4.79	4.79	0.90	1.08	±12.1%
2450	39.2	1.80	4.66	4.66	4.66	0.90	1.08	±12.1%
2600	39.0	1.96	4.40	4.40	4.40	0.80	1.21	±12.1%

^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.

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

^e Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for 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] ^c	Relative Permittivity ^d	Conductivity (S/m) ^e	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^h (mm)	Unc ⁱ (k=2)
750	55.5	0.96	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	4.76	4.76	4.76	0.65	1.27	±12.1%
2000	53.3	1.52	4.80	4.80	4.80	0.87	1.27	±12.1%
2300	52.9	1.81	4.46	4.46	4.46	0.90	1.15	±12.1%
2450	52.7	1.95	4.31	4.31	4.31	0.78	1.28	±12.1%
2600	52.5	2.16	4.14	4.14	4.14	0.90	1.10	±12.1%

^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.

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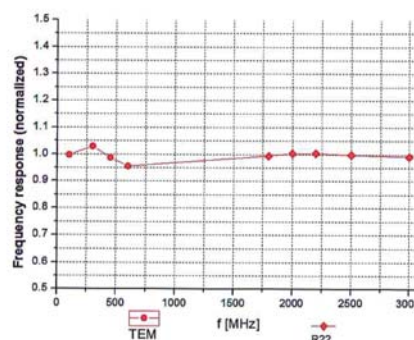
Certificate No: Z18-60398

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

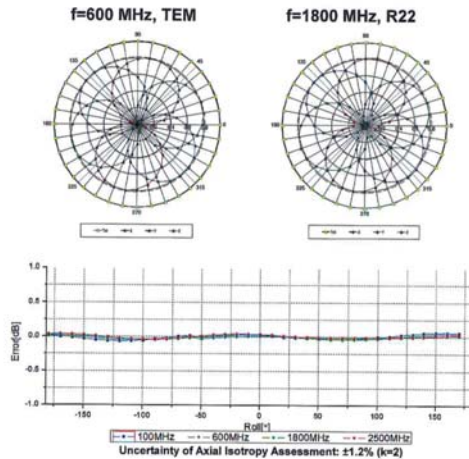


Uncertainty of Frequency Response of E-field: ±7.4% (k=2)

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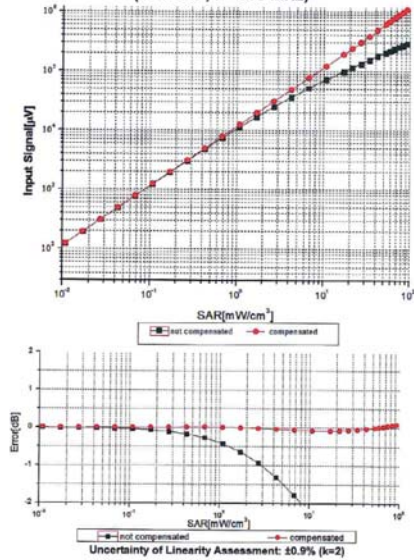
Receiving Pattern (Φ), $\theta=0^\circ$



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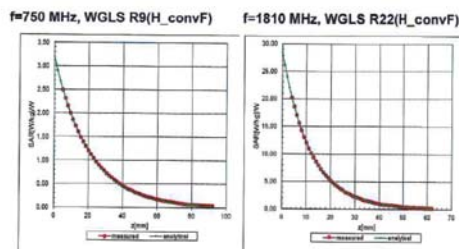
Dynamic Range f(SAR_{head})
(TEM cell, $f = 900$ MHz)



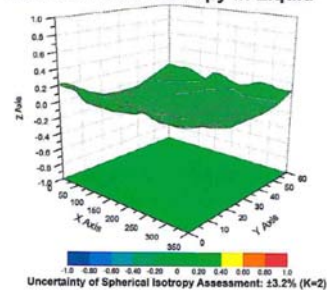
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Conversion Factor Assessment



Deviation from Isotropy in Liquid



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Appendix: Modulation Calibration Parameters

UID	Communication System Name	PAR	A dB	B dBμV	C	VR mV	Unc [±] (k=2)
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 4.83	66.08	19.33	130.9	$\pm 1.9\%$
			Y 4.79	66.02	19.29	129.3	
			Z 4.81	66.61	19.42	141.9	
10297	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	5.81	X 6.13	66.43	19.26	140.7	$\pm 1.9\%$
			Y 6.14	66.52	19.33	139.6	
			Z 6.14	66.52	19.33	139.6	

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D750V3 Sn:1101

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Client: **SRTC** Certificate No: **Z17-97134**

CALIBRATION CERTIFICATE

Object: D750V3 - SN: 1101

Calibration Procedure(s): FF-Z11-003-01
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&E critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by Certificate No.)	Scheduled Calibration
Power Meter NRV0	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.J17X00280)	Jan-18
Network Analyzer E5071C	MY46111013	13-Jan-17 (CTTL No.J17X00285)	Jan-18

Calibrated by: Zhao Jing SAR Test Engineer

Reviewed by: Yu Zongying SAR Test Engineer

Approved by: Qi Diqiyuan SAR Project Leader

Issued: September 16, 2017

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Glossary:
TSL: tissue simulating liquid
CorrF: 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, "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) DASY4/5 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	52.10.0.1446
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	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	41.5 ± 6 %	0.88 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---

SAR result with Head TSL

	Condition	
SAR averaged over 1 cm ³ (1 g) of Head TSL		
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		
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	0.96 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

	Condition	
SAR averaged over 1 cm ³ (1 g) of Body TSL		
SAR measured	250 mW input power	2.15 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	8.69 mW / g ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL		
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	53.90 ± 0.24 Ω
Return Loss	- 28.4 dB

Antenna Parameters with Body TSL

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

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 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

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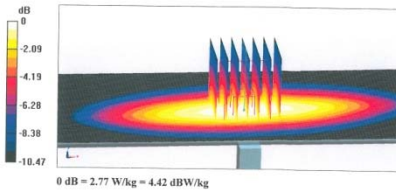
D750V3 Sn:1101



DASY5 Validation Report for Head TSL Date: 09.13.2017
Test Laboratory: CTTL, Beijing, China
DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1101
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 750$ MHz; $\sigma = 0.879$ S/m; $\epsilon_r = 41.54$; $\rho = 1000$ kg/m³
Phantom section: Left Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(10.01, 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: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Dipole Calibration/Zoom Scan (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) = 2.05 W/kg; SAR(10 g) = 1.34 W/kg
Maximum value of SAR (measured) = 2.77 W/kg

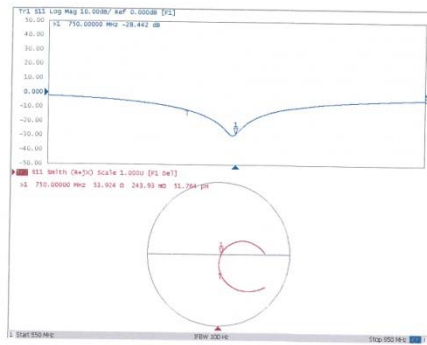


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Impedance Measurement Plot for Head TSL



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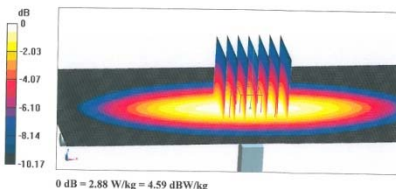
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DASY5 Validation Report for Body TSL Date: 09.13.2017
Test Laboratory: CTTL, Beijing, China
DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1101
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 750$ MHz; $\sigma = 0.946$ S/m; $\epsilon_r = 55.41$; $\rho = 1000$ kg/m³
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(9.83, 9.83, 9.83); 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) (Cube 0): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 53.35 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.27 W/kg
SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.42 W/kg
Maximum value of SAR (measured) = 2.88 W/kg

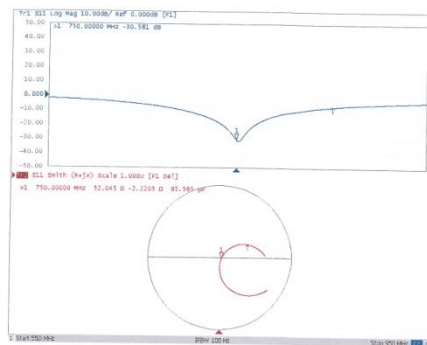


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Impedance Measurement Plot for Body TSL



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D1800V2 Sn:2d084

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Client: **SRTC** Certificate No: **Z17-97138**

CALIBRATION CERTIFICATE

Object: D1800V2 - SN: 2d084

Calibration Procedure(s): FF-Z11-003-01
Calibration Procedures for dipole validation kits

Calibration date: September 15, 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(23±3)°C and humidity<70%.

Calibration Equipment used (M&E critical for calibration)

Primary Standards	ID #	Cal Date/Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	102196	02-Mar-17 (CITL, No.J17X01254)	Mar-18
Power sensor NRP-Z91	100596	02-Mar-17 (CITL, No.J17X01254)	Mar-18
Reference Probe EX3DVA	SN 7433	26-Sep-16(SPEAG, No EX3-7433_Sep16)	Sep-17
DAE4	SN 1331	19-Jan-17(CITL-SPEAG, No Z17-97015)	Jan-18

Secondary Standards	ID #	Cal Date/Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY43071430	13-Jan-17 (CITL, No.J17X02285)	Jan-18
Network Analyzer E5071C	MY46110873	13-Jan-17 (CITL, No.J17X02285)	Jan-18

Calibrated by: Zhao Jing Function: SAR Test Engineer Signature: [Signature]

Reviewed by: Yu Zongying Function: SAR Test Engineer Signature: [Signature]

Approved by: Qi Dianyan Function: SAR Project Leader Signature: [Signature]

Issued: September 18, 2017

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Glossary:
TSL: Issue simulating liquid
ConvF: sensitivity in TSL / NORMx,y,z
N/A: not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 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
- KDB665664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: Z17-97138

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Measurement Conditions

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

DASY Version	DASY52	52.10.5.1446
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	1800 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	40.4 ± 6 %	1.42 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---

SAR result with Head TSL

	Condition	
SAR averaged over 1 cm ³ (1 g) of Head TSL		
SAR measured	250 mW input power	9.78 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		
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)

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	53.8 ± 6 %	1.50 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	---	---

SAR result with Body TSL

	Condition	
SAR averaged over 1 cm ³ (1 g) of Body TSL		
SAR measured	250 mW input power	9.84 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		
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)

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.30 - 1.55jΩ
Return Loss	- 35.4dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.00 - 1.32jΩ
Return Loss	- 27.1dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.318 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.

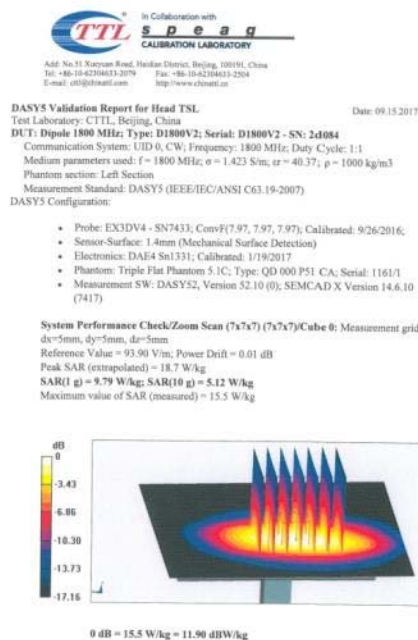
Additional EUT Data

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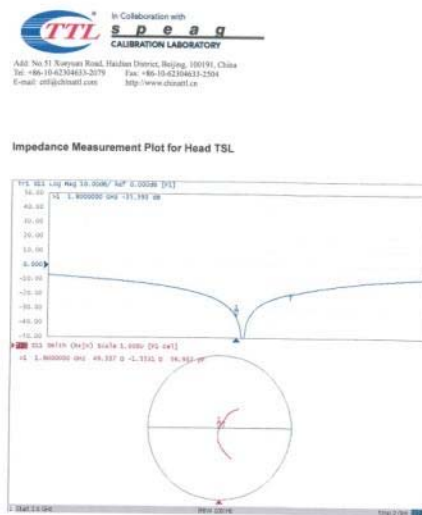
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D1800V2 Sn:2d084



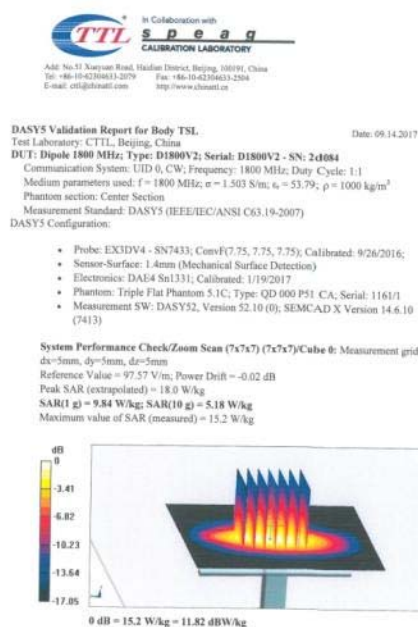
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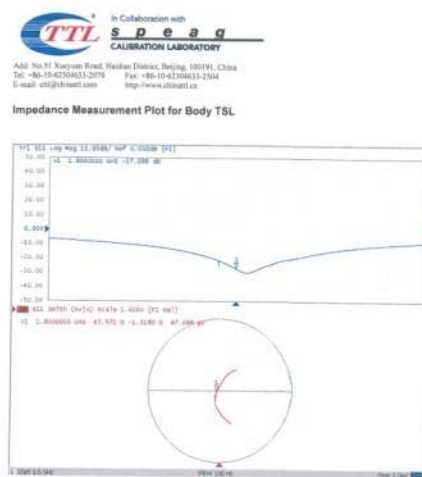
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D2000V2 Sn:1009

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Client: **SRTC** Certificate No: **Z18-97021**

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(23±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-25	102096	02-Mar-17 (CTTL No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 1464	12-Sep-17(SPEAG)No.E3X3-7464_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 E4438C	MY49071430	23-Jan-18 (CTTL No.J18X00580)	Jan-19
Network Analyzer E5071C	MY40110073	24-Jan-18 (CTTL No.J18X00581)	Jan-19

Calibrated by: Zhao Jing SAR Test Engineer Signature: [Signature]

Reviewed by: Lin Hao SAR Test Engineer [Signature]

Approved by: Qi Dianyun SAR Project Leader [Signature]

Issued: February 4, 2018

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Glossary:
TSL: Issue 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, "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) KDS895654, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:
a) DAS14/5 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	52.10.0.1448
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

	Condition	
SAR averaged over 1 cm ³ (1 g) of Head TSL		
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		
SAR measured	250 mW input power	5.17 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

	Condition	
SAR averaged over 1 cm ³ (1 g) of Body TSL		
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		
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	48.80 - 2.08jΩ
Return Loss	-33.6dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.30 - 1.63jΩ
Return Loss	-27.6dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.047 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.

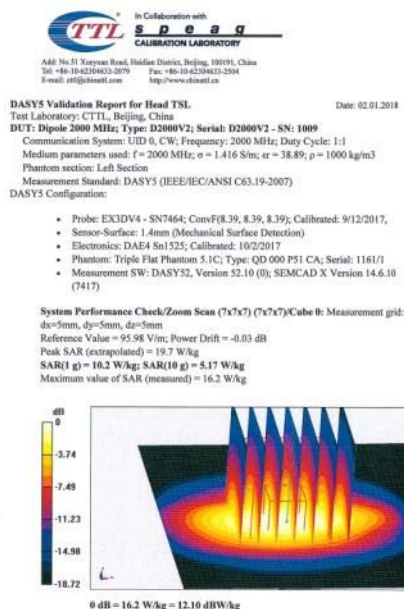
Additional EUT Data

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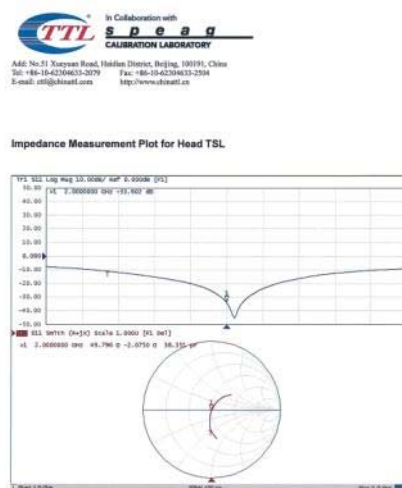
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D2000V2 Sn:1009



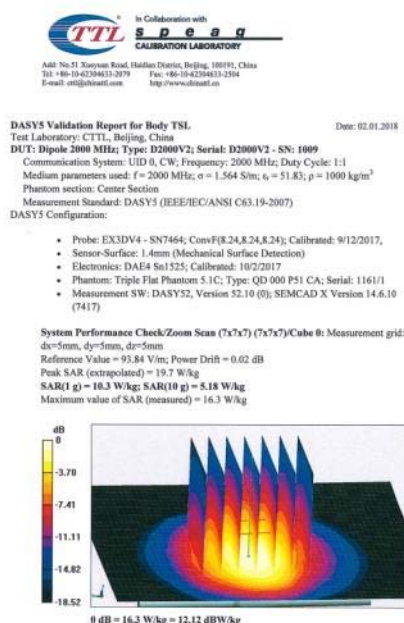
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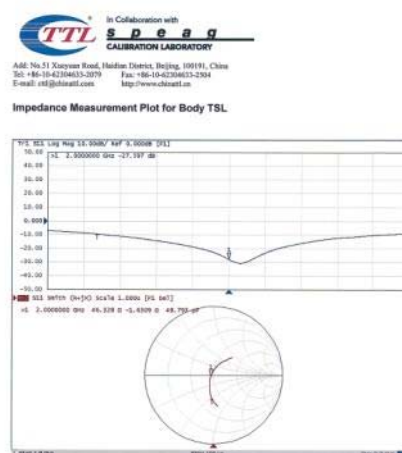
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-----End of the test report-----