Test Laboratory: Huatongwei International Inspection Co., Ltd., SAR Lab Da

Date: 12/5/2023

BT Body

Communication System: UID 0, Generic BT (0); Frequency: 2441 MHz;Duty Cycle: 1:1 Medium parameters used (interpolated): f = 2441 MHz; $\sigma = 1.803$ S/m; $\varepsilon_r = 40.148$; $\rho = 1000$ kg/m³ Phantom section: Flat Section

Ambient Temperature:22.5°C;Liquid Temperature:21.8°C

DASY Configuration:

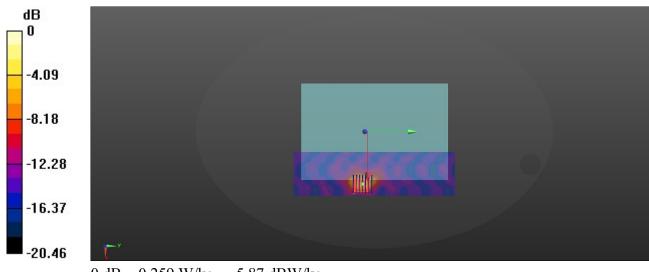
- Probe: EX3DV4 SN7494; ConvF(8.01, 8.01, 8.01) @ 2441 MHz; Calibrated: 4/17/2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1549; Calibrated: 3/27/2023
- Phantom: ELI V8.0 ; Type: QD OVA 004 AA ; Serial: 2078
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Rear 0mm/CH39/Area Scan (61x221x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Info: Interpolated medium parameters used for SAR evaluation. Maximum value of SAR (interpolated) = 0.194 W/kg

Rear 0mm/CH39/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 1.725 V/m; Power Drift = -0.13 dB Peak SAR (extrapolated) = 0.350 W/kg SAR(1 g) = 0.125 W/kg; SAR(10 g) = 0.047 W/kg

Info: Interpolated medium parameters used for SAR evaluation. Maximum value of SAR (measured) = 0.259 W/kg



0 dB = 0.259 W/kg = -5.87 dBW/kg

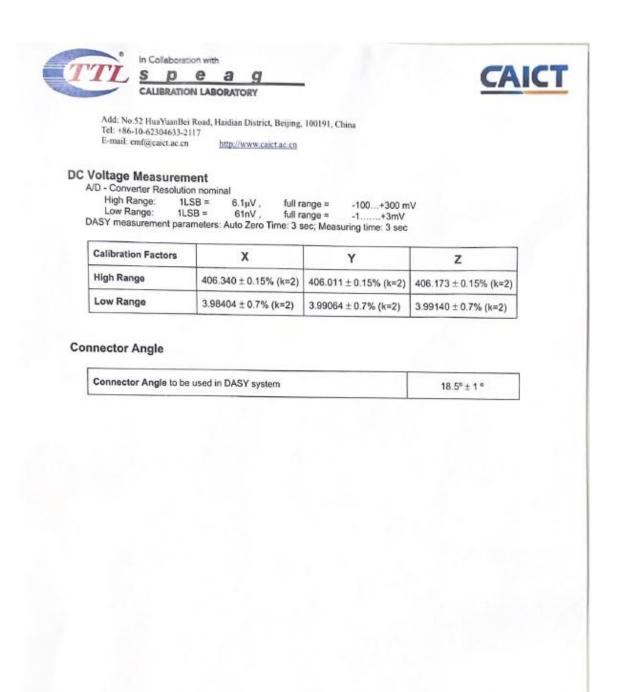
1. DAE4 Calibration Certificate

Tel: +86-10-62304633-2117 E-mail: emf@caict.ac.en	I, Haidian District, Beij http://www.caict.ac.	ning, 100191, China Mahaladada	CALIBRATION CNAS L0570
Client : HT	N	Certificate	No: J23Z60202
CALIBRATION	CERTIFICA	TE	
Object	DAE4	- SN: 1549	
Calibration Procedure(s)	FE-71	11-002-01	
	5 8 A 10 10	ration Procedure for the Data Acquisi	tion Electronics
Calibration date:	March	h 27, 2023	
humidity<70%.	een conducted in	the closed laboratory facility: environ	ment temperature(22±3)°C and
All calibrations have be humidity<70%. Calibration Equipment u	een conducted in sed (M&TE critical		ment temperature(22±3)℃ and Scheduled Calibration
All calibrations have be humidity<70%. Calibration Equipment u Primary Standards	een conducted in sed (M&TE critical	l for calibration)	
All calibrations have be humidity<70%. Calibration Equipment u Primary Standards	een conducted in sed (M&TE critical ID # C 1971018	l for calibration) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
All calibrations have be humidity<70%. Calibration Equipment u Primary Standards Process Calibrator 753	een conducted in sed (M&TE critical	l for calibration) Cal Date(Calibrated by, Certificate No.) 14-Jun-22 (CTTL, No.J22X04180)	Scheduled Calibration Jun-23
All calibrations have be humidity<70%. Calibration Equipment u Primary Standards Process Calibrator 753 Calibrated by:	een conducted in sed (M&TE critical ID # C 1971018 Name	I for calibration) Cal Date(Calibrated by, Certificate No.) 14-Jun-22 (CTTL, No.J22X04180) Function	Scheduled Calibration Jun-23
All calibrations have be	een conducted in sed (M&TE critical ID # C 1971018 Name Yu Zongying	I for calibration) Cal Date(Calibrated by, Certificate No.) 14-Jun-22 (CTTL, No.J22X04180) Function SAR Test Engineer	Scheduled Calibration Jun-23

TTL s p	e a g	CAICT
CALIBRAT	TON LABORATORY	
	Bei Road, Haidian District, Beijing, 100191, China	
Tel: +86-10-6230463 E-mail: emf@caict.ac		
Glossary:		
DAE	data acquisition electronics	
Connector angle	information used in DASY system to to the robot coordinate system.	align probe sensor X

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.

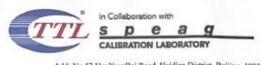


2. Probe Calibration Certificate

Add: No.52 HuaYuanBei Road, I Tel: +86-10-62304633-2117 E-mail: emf/iteaict.ac.en h	laidian District, Beijing	"Indahala"	CNAS L0570
Client HTW		Certificate No: 2	Z23-60186
CALIBRATION CER	TIFICATE		C PROFESSION
Object	EX3DV4 - S	N : 7494	
Calibration Procedure(s)			
canoration Procedure(s)	FF-Z11-004-		
	Calibration F	Procedures for Dosimetric E-field Probes	
Calibration date:	April 17, 202	3	
		incertainties with confidence probability are	given on the following
pages and are part of the certif All calibrations have been co humidity<70%. Calibration Equipment used (M	icate. onducted in the c	closed laboratory facility: environment te libration)	mperature(22±3)°C and
pages and are part of the certif All calibrations have been co humidity<70%.	icate. onducted in the o 1&TE critical for ca	closed laboratory facility: environment te	
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TTL	In Collaboration with Speag
	CALIBRATION LABORATORY
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E-mail: emf@	2304633-2117 jeaiet.ac.en http://www.eaiet.ac.en
Glossary:	
TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A,B,C,D	modulation dependent linearization parameters
Polarization Φ	 Φ rotation around probe axis θ rotation around an axis that is in the plane normal to probe axis (at measurement center)
Polarization 0	e rotation around an axis that is in the plane normal to proce axis (or measurement of the θ=0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system
Calibration is F	Performed According to the Following Standards:
a) IEEE Std 152	98-2013 "IEEE Recommended Practice for Determining the Peak Spatial-Averaged
Specific Absor	ption Rate (SAR) in the Human Head from Wireless Communications Devices:
Measurement 1	Techniques" June 2013
b) IEC 62209-1,	"Measurement procedure for the assessment of Specific Absorption Rate (SAR) from
	body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)",
July 2016	Procedure to determine the Specific Absorption Rate (SAR) for wireless communication
devices used i 2010	in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March
d) KDB 865664. "	SAR Measurement Requirements for 100 MHz to 6 GHz"
Methods Applie	ed and Interpretation of Parameters:
 NORMx, y, z: / 	Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide).
NORMx,y,z a	are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the
	ertainty inside TSL (see below ConvF).
 NORM(f)x,v,z 	z = NORMx, v, z* frequency response (see Frequency Response Chart). This
linearization i	is implemented in DASY4 software versions later than 4.2. The uncertainty of the
frequency res	sponse is included in the stated uncertainty of ConvF.
 DCPx, y, z: DC 	CP are numerical linearization parameters assessed based on the data of power sweep
(no uncertain	ty required). DCP does not depend on frequency nor media.
	the Peak to Average Ratio that is not calibrated but determined based on the signal
characteristic	S.
 Ax, y, z; Bx, y, z 	r; Cx, y, z; VRx, y, z:A, B, C are numerical linearization parameters assessed based on the r sweep for specific modulation signal. The parameters do not depend on frequency nor
madia VR in	the maximum calibration range expressed in RMS voltage across the diode.
 ConvE and B 	coundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature
Trapefer Stor	adard for f≤800MHz) and inside waveguide using analytical field distributions based on
nower measu	inements for f >800MHz. The same setups are used for assessment of the parameters
applied for bo	oundary compensation (alpha, depth) of which typical uncertainty valued are given.
These param	eters are used in DASY4 software to improve probe accuracy close to the boundary.
The sensitivit	y in TSL corresponds to NORMx,y,z* ConvF whereby the uncertainty corresponds to
that given for	ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which
allows extend	ting the validity from±50MHz to±100MHz.
	tropy (3D deviation from isotropy): in a field of low gradients realized using a flat
nhantom exp	osed by a patch antenna.
priditionitorip	t: The sensor offset corresponds to the offset of virtual measurement center from the
 Sensor Offse 	probe sviet bio telerance required
 Sensor Offse probe tip (on 	probe axis). No tolerance required.
 Sensor Offse probe tip (on 	ngle: The angle is assessed using the information gained by determining the NORMx

CAICT



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DASY/EASY - Parameters of Probe: EX3DV4 - SN:7494

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(µV/(V/m)2)^	0.40	0.47	0.41	±10.0%
DCP(mV) ^a	97.0	98.5	97.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dBõV	c	D dB	VR mV	Unc ^E (<i>k</i> =2)
0	0 CW	X	0.0	0.0	1.0	0.00	148.8	±2.0%
		Y	0.0	0.0	1.0		160.0	
		z	0.0	0.0	1.0		149.1	

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 4). ^B Numerical linearization parameter: uncertainty not required.

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





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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7494

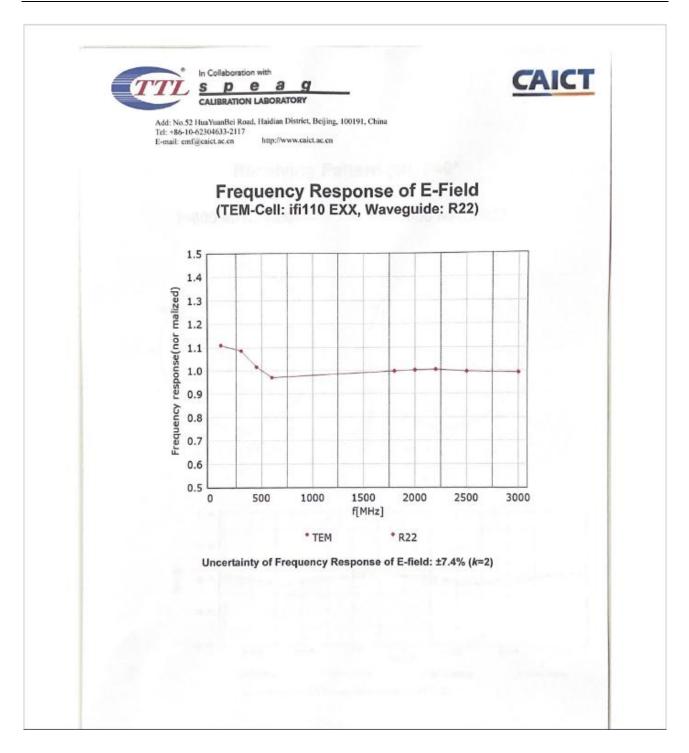
Calibration Parameter Determined in Head Tissue Simulating Media

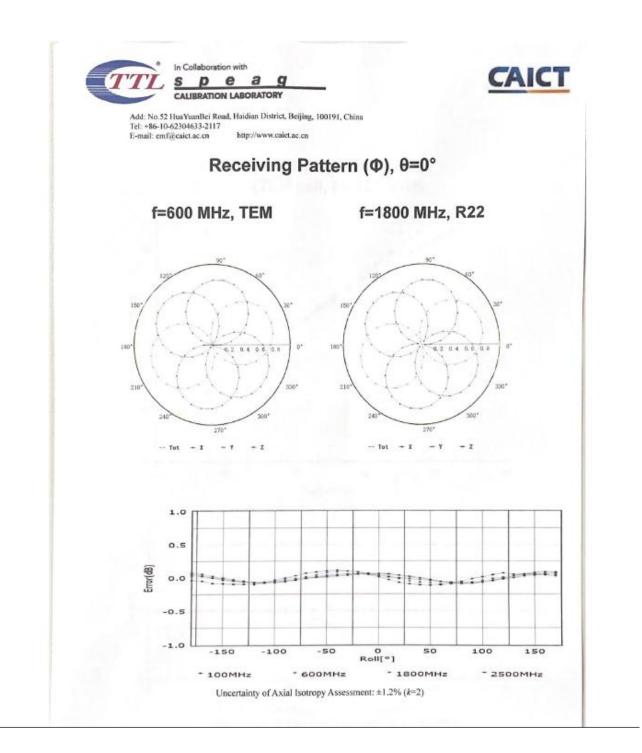
f [MHz] ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	10.80	10.80	10.80	0.13	1.41	±12.7%
835	41.5	0.90	10.40	10.40	10.40	0.12	1.50	±12.7%
1750	40.1	1.37	8.99	8.99	8.99	0.26	0.92	±12.7%
1900	40.0	1.40	8.64	8.64	8.64	0.26	1.03	±12.7%
2000	40.0	1.40	8.73	8.73	8.73	0.23	1.04	±12.7%
2300	39.5	1.67	8.35	8.35	8.35	0.63	0.64	±12.7%
2450	39.2	1.80	8.01	8.01	8.01	0.33	0.99	±12.7%
2600	39.0	1.96	7.83	7.83	7.83	0.55	0.71	±12.7%
5250	35.9	4.71	5.67	5.67	5.67	0.40	1.55	±13.9%
5600	35.5	5.07	5.07	5.07	5.07	0.45	1.45	±13.9%
5750	35.4	5.22	5.14	5.14	5.14	0.40	1.55	±13.9%

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

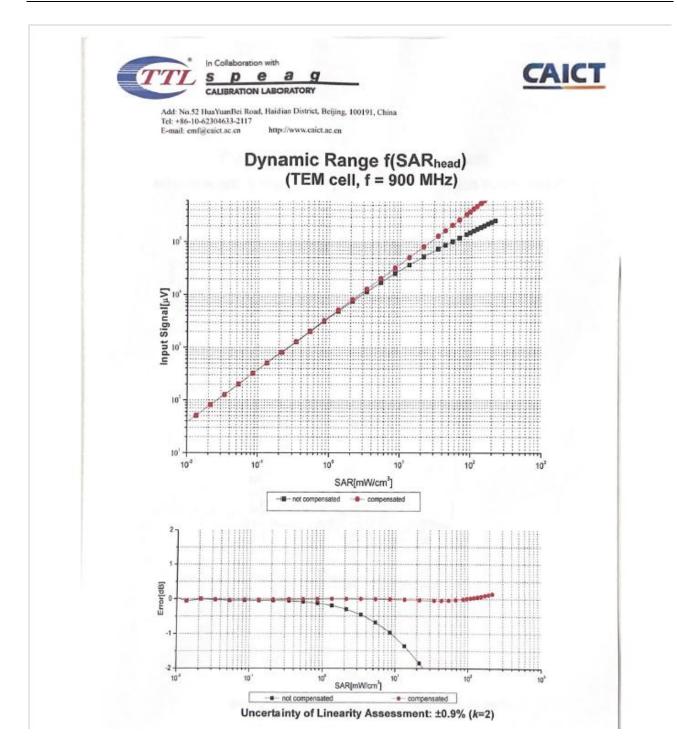
^F At frequency up to 6 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

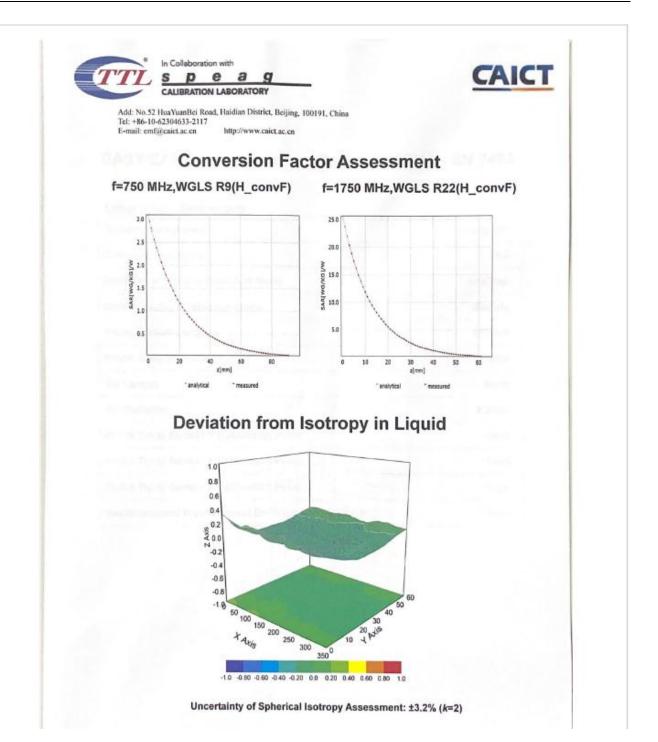
^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than \pm 1% for frequencies below 3 GHz and below \pm 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter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





Appendix E: DAE and Probe Calibration Certificate





Other Probe Parameters	
Sensor Arrangement	Triangular
Connector Angle (°)	23.2
Nechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

1.1. D750V3 Dipole Calibration Certificate

Add: No.51 Xueyuan Ro Tel: +86-10-62304633-2 E-mail: cttl@chinattl.com	0/9 Tax. 100 1	chinattl.cn	Z21-60	CALIBRATION CNAS L0570
Client HTW		Certificate No:	221-00	
ALIBRATION CER	TIFICATE			100000000000000000000000000000000000000
	3.44			1000
bject	D750V3 -	SN: 1180		
alibration Procedure(s)	FF-Z11-0	01		1.1.
alloration Procedure(o)	Calibratio	n Procedures for dipole validation ki	its	
	1.1			50.5
alibration date:	January 2	22, 2021 aceability to national standards, wh		
	ificate.	in the sectory facility envir	onment ten	nperature(22±3)°C ar
numidity<70%.	conducted in th	e closed laboratory facility: envir	onment ten	nperature(22±3)°C ar
numidity<70%. Calibration Equipment used (conducted in th	r calibration)		Scheduled Calibratio
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Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "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%.

Certificate No: Z21-60016

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S e p g а CALIBRATION LABORATORY

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Measurement Conditions

DASY Version	DASY52	V52.10.4
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	42.3 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

SAR result with Head TSL

Condition	
250 mW input power	2.13 W/kg
normalized to 1W	8.43 W/kg ± 18.8 % (k=2)
Condition	
250 mW input power	1.41 W/kg
normalized to 1W	5.59 W/kg ± 18.7 % (k=2)
	250 mW input power normalized to 1W Condition 250 mW input power

Certificate N	: Z21-60016
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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.6Ω- 1.34jΩ	
Return Loss	- 28.6dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	0.944 ns
Electrical Boldy (one anotabily	

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by		SPEAG	
	14		
tificate No: Z21-60016	Page 4 of 6		



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DASY5 Validation Report for Head TSL

Date: 01.22.2021

Test Laboratory: CTTL, Beijing, China DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1180

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 750 MHz; $\sigma = 0.905$ S/m; $\varepsilon_r = 42.25$; $\rho = 1000$ kg/m3

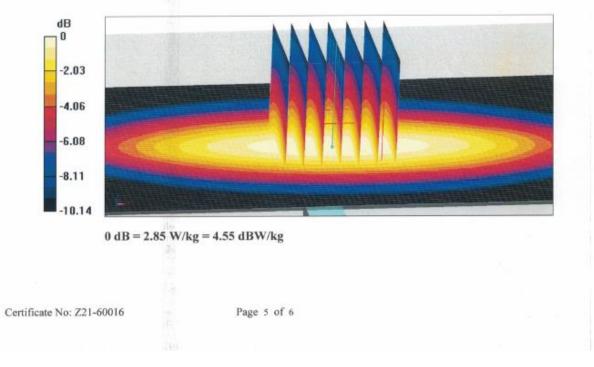
Phantom section: Right Section

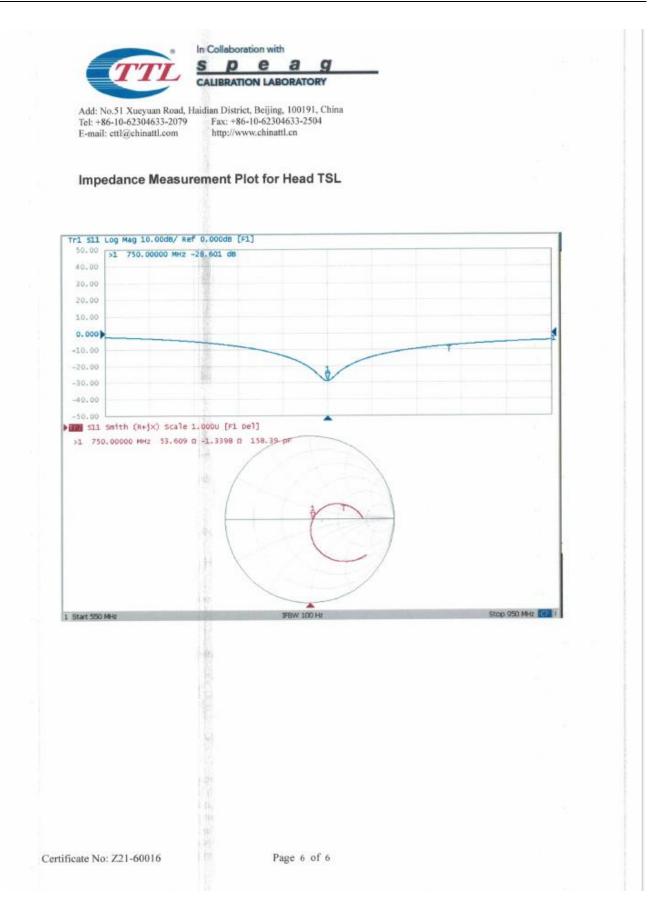
DASY5 Configuration:

- Probe: EX3DV4 SN7600; ConvF(10.88, 10.88, 10.88) @ 750 MHz; Calibrated: 2020-11-30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2020-02-10
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

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

Reference Value = 54.99 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 3.25 W/kg SAR(1 g) = 2.13 W/kg; SAR(10 g) = 1.41 W/kg Smallest distance from peaks to all points 3 dB below = 22.7 mm Ratio of SAR at M2 to SAR at M1 = 65.6% Maximum value of SAR (measured) = 2.85 W/kg





Extended Dipole Calibrations

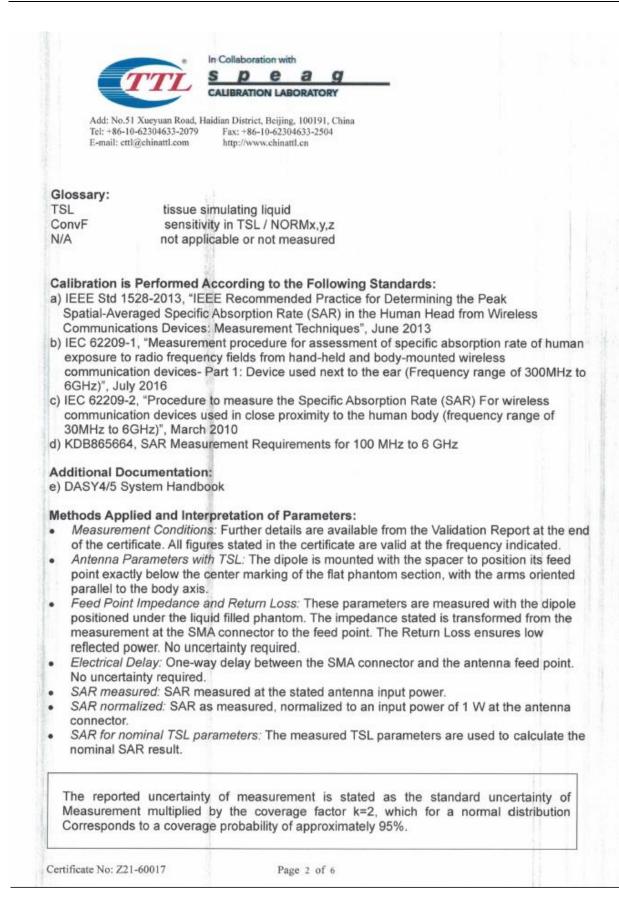
Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

			Head-750			
Date of	Poturn loop (dP)	Dolto (9())	Real Impedance	Delta	Imaginary	Delta
measurement	Return-loss (dB)	Delta (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2021-01-22	-28.6		53.6		-1.34	
2022-01-17	-28.1	-1.75	53.5	0.1	-1.11	0.23
2023-01-15	-28.3	-1.05	53.3	0.3	-1.22	0.12

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 50hm of prior calibration. Therefore the verification result should support extended calibration.

1.2. D835V2 Dipole Calibration Certificate

		TION LABORATORY	Hac-MRA	GNA	AS 校准	RATION
Add: No.51 Xueyu Tel: +86-10-62304 E-mail: cttl@china	633-2079 Fax:	strict, Beijing, 100191, Chir +86-10-62304633-2504 /www.chinattl.cn	na manulululu			L0570
Client HTW			Certificate No:	Z21-600	17	
CALIBRATION C	ERTIFICAT	F	and the second second	14.5 3 77	Laured Keels	
CALIBITATION	LINITION			2	1.000	
Object	D8351	2 - SN: 4d238			100	
- Jeon	D035V	2 - 511, 40250				
Calibration Procedure(s)	FE-71	-003-01				
	and the second	tion Procedures for d	lipole validation kits			
Collibration data:	11 August 199					
Calibration date:	Januar	y 22, 2021				
All collibrations have been	a conducted in	the closed leberates	a facility anyirang	nont tompo		in and
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4	d (M&TE critical f ID # 106276 101369 SN 7600 SN 771	or calibration) Cal Date(Calibrate 12-May-20 (CTTL, I 12-May-20 (CTTL, I 30-Nov-20(CTTL-SI 10-Feb-20(CTTL-SI	d by, Certificate No No.J20X02965) No.J20X02965) PEAG,No.Z20-6001 PEAG,No.Z20-6001	.) Sche 21) 17)	eduled Calibr May-21 May-21 Nov-21 Feb-21	ation
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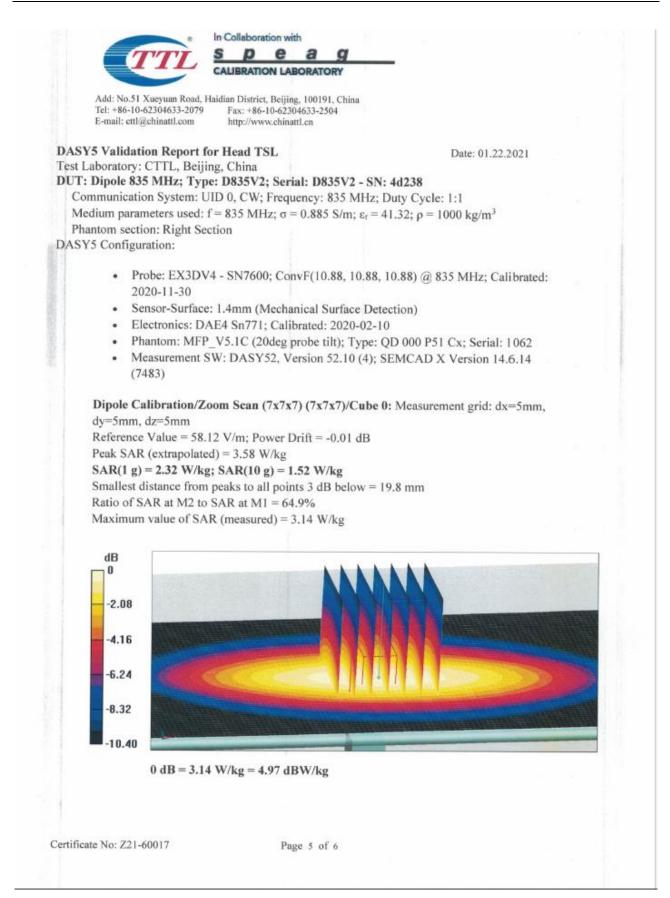


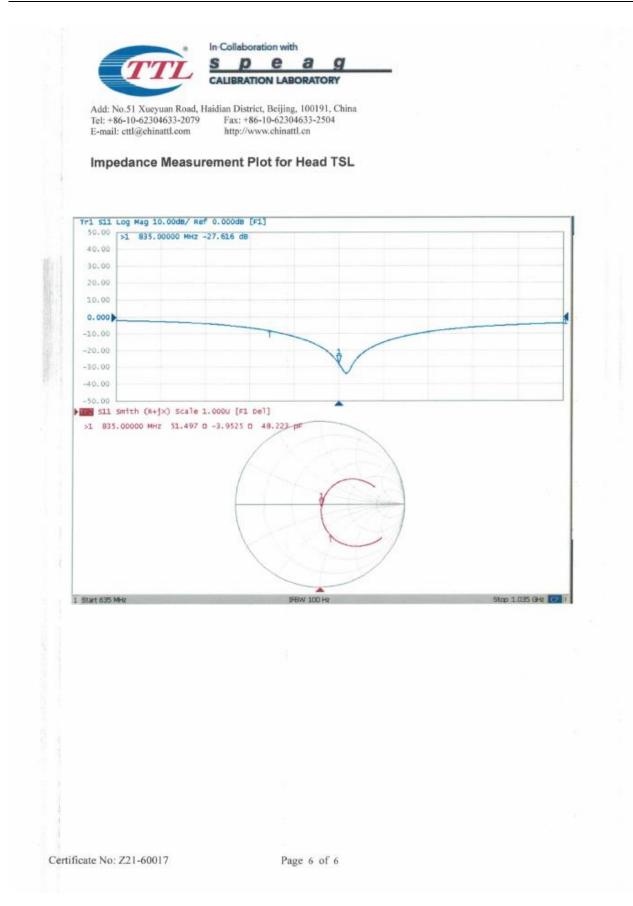
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DASY system configuration, as f	ar as not given o	n page 1.			
DASY Version		DASY52			V52.10.4
Extrapolation	Advand	ced Extrapolation			
Phantom	Triple	Flat Phantom 5.1C			
Distance Dipole Center - TSL		15 mm		6	with Spacer
Zoom Scan Resolution	dx,	dy, dz = 5 mm			
Frequency	835	MHz ± 1 MHz			
lead TSL parameters The following parameters and ca	culations were a	pplied. Temperature	Permitti	vitv	Conductivity
Nominal Head TSL paramete	rs	22.0 °C	41.5		0.90 mho/m
Measured Head TSL paramet		(22.0 ± 0.2) °C	41.3 ± 0	3 %	0.89 mho/m ± 6 %
tota ano astro da la companya da la companya da companya da companya da companya da companya da companya da com		<1.0 °C			
Head ISL temperature chance	c canng core				
Head TSL temperature changes		1 Con 1 Con 1	ion		
SAR averaged over 1 cm ³ (1	g) of Head TSL	Condit			2.32 W/kg
AR result with Head TSL	g) of Head TSL	250 mW in	put power	1	
SAR result with Head TSL SAR averaged over 1 cm ³ (1		07.0223		9.39	W/kg ± 18.8 % (k=2)
SAR result with Head TSL SAR averaged over 1 cm ³ (1 SAR measured	ameters	250 mW in normalize	d to 1W	9.39	W/kg ± 18.8 % (k=2)
AR result with Head TSL SAR averaged over 1 cm ³ (1 SAR measured SAR for nominal Head TSL par	ameters	250 mW in normalize	d to 1W ion	9.39	W/kg ± 18.8 % (k=2) 1.52 W/kg

Certificate No: Z21-60017

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Appendix (Additional ass	essments outside the sco	pe of CNAS L0570)	
Antenna Parameters with	Head ISL		
Impedance, transformed to fee	ed point	51.5Ω- 3.95jΩ	
Return Loss		- 27.6dB	
General Antenna Paramet	ers and Design		
Electrical Delay (one direction)		1.298 ns	
he measured. The dipole is made of standard onnected to the second arm of f the dipoles, small end caps an ccording to the position as exp ffected by this change. The over lo excessive force must be app	semirigid coaxial cable. The cer the dipole. The antenna is there re added to the dipole arms in c lained in the "Measurement Col erall dipole length is still accordi blied to the dipole arms, because	nter conductor of the feeding afore short-circuited for DC-s rder to improve matching wi aditions" paragraph. The SAI ng to the Standard.	line is directly signals. On some nen loaded R data are not
onnected to the second arm of f the dipoles, small end caps an according to the position as exp ffected by this change. The ove lo excessive force must be app onnections near the feedpoint r additional EUT Data	semirigid coaxial cable. The cer the dipole. The antenna is there re added to the dipole arms in c lained in the "Measurement Col erall dipole length is still accordi blied to the dipole arms, because	nter conductor of the feeding offore short-circuited for DC-s rder to improve matching wh aditions" paragraph. The SAI ng to the Standard. In the Standard or the solo	line is directly signals. On some nen loaded R data are not
he measured. The dipole is made of standard sonnected to the second arm of f the dipoles, small end caps an ccording to the position as expl ffected by this change. The over lo excessive force must be app onnections near the feedpoint r	semirigid coaxial cable. The cer the dipole. The antenna is there re added to the dipole arms in c lained in the "Measurement Col erall dipole length is still accordi blied to the dipole arms, because	nter conductor of the feeding afore short-circuited for DC-s rder to improve matching wi aditions" paragraph. The SAI ng to the Standard.	line is directly signals. On some nen loaded R data are not
The measured. The dipole is made of standard of onnected to the second arm of if the dipoles, small end caps an occording to the position as exp ffected by this change. The over the excessive force must be app onnections near the feedpoint of additional EUT Data	semirigid coaxial cable. The cer the dipole. The antenna is there re added to the dipole arms in c lained in the "Measurement Col erall dipole length is still accordi blied to the dipole arms, because	nter conductor of the feeding offore short-circuited for DC-s rder to improve matching wh aditions" paragraph. The SAI ng to the Standard. In the Standard or the solo	line is directly signals. On some nen loaded R data are not
The measured. The dipole is made of standard of onnected to the second arm of if the dipoles, small end caps an occording to the position as exp ffected by this change. The over the excessive force must be app onnections near the feedpoint of additional EUT Data	semirigid coaxial cable. The cer the dipole. The antenna is there re added to the dipole arms in c lained in the "Measurement Col erall dipole length is still accordi blied to the dipole arms, because	nter conductor of the feeding offore short-circuited for DC-s rder to improve matching wh aditions" paragraph. The SAI ng to the Standard. In the Standard or the solo	line is directly signals. On some nen loaded R data are not
The measured. The dipole is made of standard of onnected to the second arm of if the dipoles, small end caps an occording to the position as exp ffected by this change. The over the excessive force must be app onnections near the feedpoint of additional EUT Data	semirigid coaxial cable. The cer the dipole. The antenna is there re added to the dipole arms in c lained in the "Measurement Col erall dipole length is still accordi blied to the dipole arms, because	nter conductor of the feeding offore short-circuited for DC-s rder to improve matching wh aditions" paragraph. The SAI ng to the Standard. In the Standard or the solo	line is directly signals. On some nen loaded R data are not
The measured. The dipole is made of standard of onnected to the second arm of if the dipoles, small end caps an occording to the position as exp ffected by this change. The over the excessive force must be app onnections near the feedpoint of additional EUT Data	semirigid coaxial cable. The cer the dipole. The antenna is there re added to the dipole arms in c lained in the "Measurement Col erall dipole length is still accordi blied to the dipole arms, because	nter conductor of the feeding offore short-circuited for DC-s rder to improve matching wh aditions" paragraph. The SAI ng to the Standard. In the Standard or the solo	line is directly signals. On some nen loaded R data are not
The measured. The dipole is made of standard of onnected to the second arm of if the dipoles, small end caps an occording to the position as exp ffected by this change. The over the excessive force must be app onnections near the feedpoint of additional EUT Data	semirigid coaxial cable. The cer the dipole. The antenna is there re added to the dipole arms in c lained in the "Measurement Col erall dipole length is still accordi blied to the dipole arms, because	nter conductor of the feeding offore short-circuited for DC-s rder to improve matching wh aditions" paragraph. The SAI ng to the Standard. In the Standard or the solo	line is directly signals. On some nen loaded R data are not
The measured. The dipole is made of standard of onnected to the second arm of if the dipoles, small end caps an occording to the position as exp ffected by this change. The over the excessive force must be app onnections near the feedpoint of additional EUT Data	semirigid coaxial cable. The cer the dipole. The antenna is there re added to the dipole arms in c lained in the "Measurement Col erall dipole length is still accordi blied to the dipole arms, because	nter conductor of the feeding offore short-circuited for DC-s rder to improve matching wh aditions" paragraph. The SAI ng to the Standard. In the Standard or the solo	line is directly signals. On some nen loaded R data are not
The measured. The dipole is made of standard of onnected to the second arm of if the dipoles, small end caps an occording to the position as exp ffected by this change. The over the excessive force must be app onnections near the feedpoint of additional EUT Data	semirigid coaxial cable. The cer the dipole. The antenna is there re added to the dipole arms in c lained in the "Measurement Col erall dipole length is still accordi blied to the dipole arms, because	nter conductor of the feeding offore short-circuited for DC-s rder to improve matching wh aditions" paragraph. The SAI ng to the Standard. In the Standard or the solo	line is directly signals. On some nen loaded R data are not
The measured. The dipole is made of standard of onnected to the second arm of if the dipoles, small end caps an occording to the position as exp ffected by this change. The over the excessive force must be app onnections near the feedpoint of additional EUT Data	semirigid coaxial cable. The cer the dipole. The antenna is there re added to the dipole arms in c lained in the "Measurement Col erall dipole length is still accordi blied to the dipole arms, because	nter conductor of the feeding offore short-circuited for DC-s rder to improve matching wh aditions" paragraph. The SAI ng to the Standard. In the Standard or the solo	line is directly signals. On some nen loaded R data are not
The measured. The dipole is made of standard of onnected to the second arm of if the dipoles, small end caps an occording to the position as exp ffected by this change. The over the excessive force must be app onnections near the feedpoint of additional EUT Data	semirigid coaxial cable. The cer the dipole. The antenna is there re added to the dipole arms in c lained in the "Measurement Col erall dipole length is still accordi blied to the dipole arms, because	nter conductor of the feeding offore short-circuited for DC-s rder to improve matching wh aditions" paragraph. The SAI ng to the Standard. In the Standard or the solo	line is directly signals. On some nen loaded R data are not





Extended Dipole Calibrations

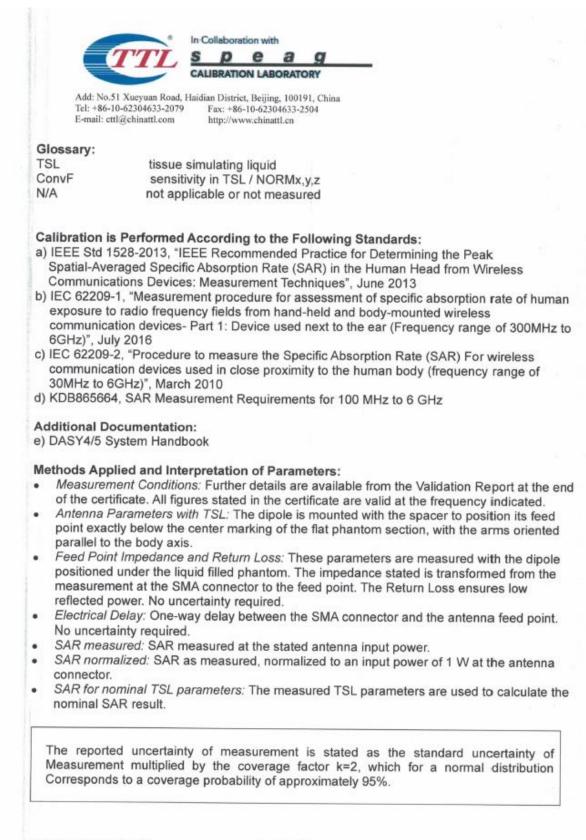
Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

			Head-835			
Date of	Poturn loop (dP)	Dolto (9/)	Real Impedance	Delta	Imaginary	Delta
measurement	Return-loss (dB)	Delta (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2022-01-22	-27.6		51.5		-3.95	
2022-01-17	-27.3	-1.09	51.8	0.3	-3.45	0.5
2023-01-15	-27.5	-0.36	51.6	0.1	-3.55	0.4

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 50hm of prior calibration. Therefore the verification result should support extended calibration.

1.3. D1750V2 Dipole Calibration Certificate

Client HTW		://www.chinattl.cn	
Chong		Certificate No: Z2	21-60018
CALIBRATION C	ERTIFICA	TE	Les Station and Station
Object	D1750	0V2 - SN: 1164	
Calibration Procedure(s)			
		1-003-01 ation Procedures for dipole validation kits	
-			
Calibration date:	Janua	ry 22, 2021	
pages and are part of the c	ertificate.		
humidity<70%. Calibration Equipment used Primary Standards	I (M&TE critical	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2	ID # 106276	for calibration) Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965)	Scheduled Calibration May-21
humidity<70%. Calibration Equipment used Primary Standards	I (M&TE critical	for calibration) Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965)	Scheduled Calibration
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A	ID # 106276 101369	for calibration) Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965)	Scheduled Calibration May-21 May-21
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4	ID # 106276 101369 SN 7600 SN 771	for calibration) Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965) 30-Nov-20(CTTL-SPEAG,No.Z20-60421) 10-Feb-20(CTTL-SPEAG,No.Z20-60017)	Scheduled Calibration May-21 May-21 Nov-21 Feb-21
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards	ID # 106276 101369 SN 7600 SN 771 ID #	for calibration) Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965) 30-Nov-20(CTTL-SPEAG,No.Z20-60421) 10-Feb-20(CTTL-SPEAG,No.Z20-60017) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration May-21 May-21 Nov-21 Feb-21 Scheduled Calibration
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4	ID # 106276 101369 SN 7600 SN 771	for calibration) Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965) 30-Nov-20(CTTL-SPEAG,No.Z20-60421) 10-Feb-20(CTTL-SPEAG,No.Z20-60017) Cal Date(Calibrated by, Certificate No.) 25-Feb-20 (CTTL, No.J20X00516)	Scheduled Calibration May-21 May-21 Nov-21 Feb-21
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ID # 106276 101369 SN 7600 SN 771 ID # MY49071430	for calibration) Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965) 30-Nov-20(CTTL-SPEAG,No.Z20-60421) 10-Feb-20(CTTL-SPEAG,No.Z20-60017) Cal Date(Calibrated by, Certificate No.) 25-Feb-20 (CTTL, No.J20X00516)	Scheduled Calibration May-21 May-21 Nov-21 Feb-21 Scheduled Calibration Feb-21
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ID # 106276 101369 SN 7600 SN 771 ID # MY49071430 MY46110673	for calibration) Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965) 30-Nov-20(CTTL-SPEAG,No.Z20-60421) 10-Feb-20(CTTL-SPEAG,No.Z20-60017) Cal Date(Calibrated by, Certificate No.) 25-Feb-20 (CTTL, No.J20X00516) 10-Feb-20 (CTTL, No.J20X00515)	Scheduled Calibration May-21 May-21 Nov-21 Feb-21 Scheduled Calibration Feb-21 Feb-21
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	ID # 106276 101369 SN 7600 SN 771 ID # MY49071430 MY46110673 Name	for calibration) Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965) 30-Nov-20(CTTL-SPEAG,No.Z20-60421) 10-Feb-20(CTTL-SPEAG,No.Z20-60017) Cal Date(Calibrated by, Certificate No.) 25-Feb-20 (CTTL, No.J20X00516) 10-Feb-20 (CTTL, No.J20X00515) Function	Scheduled Calibration May-21 May-21 Nov-21 Feb-21 Scheduled Calibration Feb-21
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	ID # 106276 101369 SN 7600 SN 771 ID # MY49071430 MY46110673	for calibration) Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965) 30-Nov-20(CTTL-SPEAG,No.Z20-60421) 10-Feb-20(CTTL-SPEAG,No.Z20-60017) Cal Date(Calibrated by, Certificate No.) 25-Feb-20 (CTTL, No.J20X00516) 10-Feb-20 (CTTL, No.J20X00515)	Scheduled Calibration May-21 May-21 Nov-21 Feb-21 Scheduled Calibration Feb-21 Feb-21
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	ID # 106276 101369 SN 7600 SN 771 ID # MY49071430 MY46110673 Name	for calibration) Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965) 30-Nov-20(CTTL-SPEAG,No.Z20-60421) 10-Feb-20(CTTL-SPEAG,No.Z20-60017) Cal Date(Calibrated by, Certificate No.) 25-Feb-20 (CTTL, No.J20X00516) 10-Feb-20 (CTTL, No.J20X00515) Function	Scheduled Calibration May-21 May-21 Nov-21 Feb-21 Scheduled Calibration Feb-21 Feb-21
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	I (M&TE critical ID # 106276 101369 SN 7600 SN 771 ID # MY49071430 MY46110673 Name Zhao Jing Lin Hao	for calibration) Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965) 30-Nov-20(CTTL-SPEAG,No.Z20-60421) 10-Feb-20(CTTL-SPEAG,No.Z20-60017) Cal Date(Calibrated by, Certificate No.) 25-Feb-20 (CTTL, No.J20X00516) 10-Feb-20 (CTTL, No.J20X00515) Function SAR Test Engineer SAR Test Engineer	Scheduled Calibration May-21 May-21 Nov-21 Feb-21 Scheduled Calibration Feb-21 Feb-21
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ID # 106276 101369 SN 7600 SN 771 ID # MY49071430 MY46110673 Name Zhao Jing	for calibration) Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965) 30-Nov-20(CTTL-SPEAG,No.Z20-60421) 10-Feb-20(CTTL-SPEAG,No.Z20-60017) Cal Date(Calibrated by, Certificate No.) 25-Feb-20 (CTTL, No.J20X00516) 10-Feb-20 (CTTL, No.J20X00515) Function SAR Test Engineer SAR Test Engineer SAR Project Leader	Scheduled Calibration May-21 May-21 Nov-21 Feb-21 Scheduled Calibration Feb-21 Feb-21



Certificate No: Z21-60018

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DASY system configuration, as far as r	ant niven a	1			
DASY Version	iot given of	DASY52	+		V52.10.4
Extrapolation	Advan	ced Extrapolation			
Phantom	Triple	Flat Phantom 5.1C			
Distance Dipole Center - TSL		10 mm			with Spacer
Zoom Scan Resolution	dx.	dy, dz = 5 mm			inter openedit
Frequency		50 MHz ± 1 MHz			
ad TSL parameters he following parameters and calculation		Temperature	Permitti	vity	-
ad TSL parameters		pplied.			
ad TSL parameters		and a second		vity	-
he following parameters and calculation		Temperature 22.0 °C	40.1		1.37 mho
Nominal Head TSL parameters Measured Head TSL parameters	ons were a	Temperature 22.0 °C (22.0 ± 0.2) °C			1.37 mho
he following parameters and calculation	ons were a	Temperature 22.0 °C	40.1		1.37 mho
he following parameters and calculation Nominal Head TSL parameters Measured Head TSL parameters Head TSL temperature change dur	ing test	Temperature 22.0 °C (22.0 ± 0.2) °C	40.1 39.8 ± 1		Conduct 1.37 mho 1.37 mho/m
Nominal Head TSL parameters Measured Head TSL parameters Head TSL temperature change dur R result with Head TSL	ing test	Temperature 22.0 °C (22.0 ± 0.2) °C <1.0 °C	40.1 39.8 ± (1.37 mho
Nominal Head TSL parameters Measured Head TSL parameters Head TSL temperature change dur R result with Head TSL SAR averaged over 1 cm^3 (1 g) of P	ing test	Temperature 22.0 °C (22.0 ± 0.2) °C <1.0 °C	40.1 39.8 ± 1 	5 %	1.37 mho 1.37 mho/m
Nominal Head TSL parameters Measured Head TSL parameters Head TSL temperature change dur R result with Head TSL SAR averaged over 1 cm ³ (1 g) of H SAR measured	ing test Head TSL	Temperature 22.0 °C (22.0 ± 0.2) °C <1.0 °C	40.1 39.8 ± 1 ion put power d to 1W	5 %	1.37 mho 1.37 mho/m 9.13 W/kg
Nominal Head TSL parameters Measured Head TSL parameters Head TSL temperature change dur R result with Head TSL SAR averaged over 1 cm ³ (1 g) of H SAR measured SAR for nominal Head TSL paramete	ing test Head TSL	Temperature 22.0 °C (22.0 ± 0.2) °C <1.0 °C	40.1 39.8 ± 1 ion put power d to 1W ion	5 %	1.37 mho 1.37 mho/m 9.13 W/kg

Certificate No: Z21-60018

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 Fax: +86-10-62304633-2504

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

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.9Ω- 3.86jΩ	
Return Loss	- 28.3 dB	

General Antenna Parameters and Design

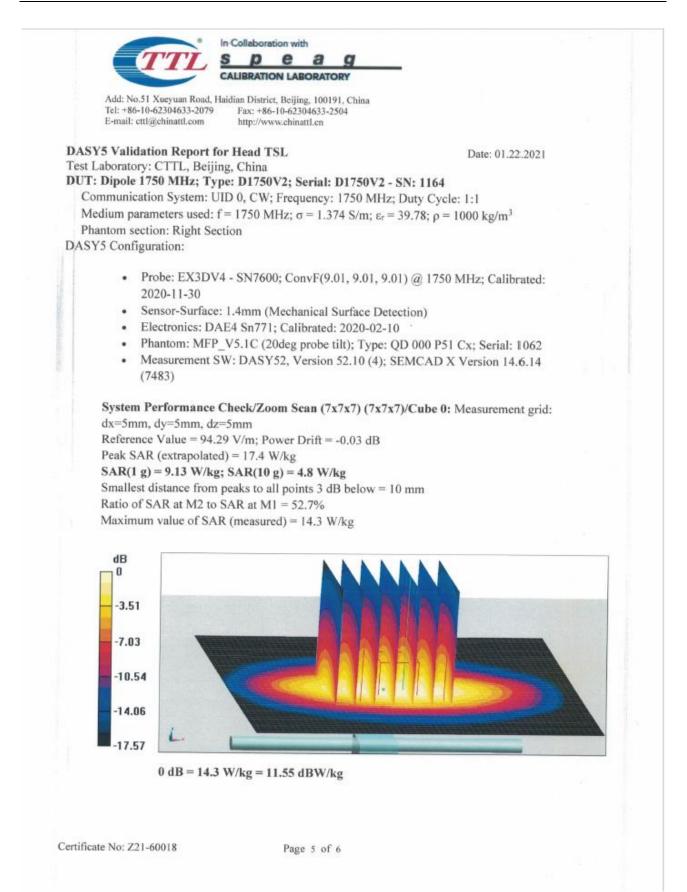
Electrical Delay (one direction)	1.124 ns
----------------------------------	----------

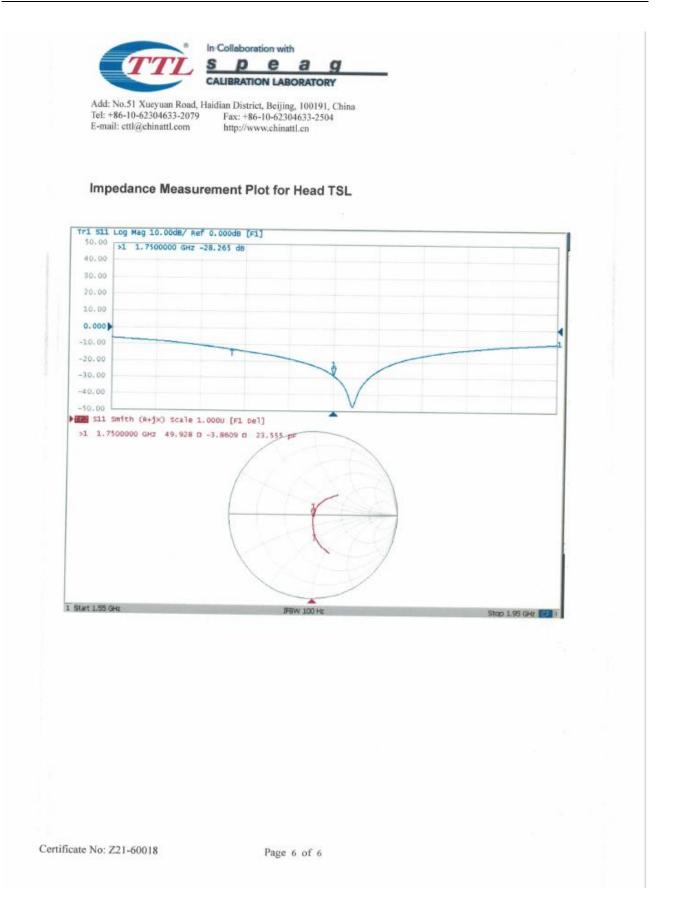
After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by		SPEAG	
ficate No: Z21-60018	Page 4 of 6		





Extended Dipole Calibrations

Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

			Head-1750			
Date of	Poturn loop (dP)	Dolto (9/)	Real Impedance	Delta	Imaginary	Delta
measurement	Return-loss (dB)	Delta (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2021-01-22	-28.3		49.9		-3.86	
2022-01-17	-27.9	-1.41	50.4	0.5	-3.46	0.4
2023-01-15	-28.1	-0.71	50.2	0.3	-3.66	0.2

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 50hm of prior calibration. Therefore the verification result should support extended calibration.

1.4. D1900V2 Dipole Calibration Certificate

E-mail: ettl@chinattl.c	inter nuplines	on chinattl cn				
1199141		vw.chinattl.cn	Certificate N	lo: Z2	1-60019	1200
Client HIW	RTIFICATE					
Dbject	D1900V2	2 - SN: 5d226	12/22/22			
calibration Procedure(s)	FF-Z11-Calibrati		for dipole validatio	n kits		
Calibration date:	January	22, 2021				
All calibrations have been	conducted in th	ne closed lab	oratory facility: en	vironmer	t temperati	ure(22±3)°C and
numidity<70%. Calibration Equipment used	(M&TE critical fo	r calibration)		11		ure(22±3)°C and
numidity<70%. Calibration Equipment used Primary Standards		r calibration) Cal Date(Ca 12-May-20 (C	librated by, Certifica	ate No.) 65)		led Calibration May-21
numidity<70%. Calibration Equipment used	(M&TE critical fo	Cal Date(Ca 12-May-20 (C 12-May-20 (C 30-Nov-20(C	librated by, Certific	ate No.) 35) 35) 20-60421)	Schedu	led Calibration
Power sensor NRP6A ReferenceProbe EX3DV4 DAE4	(M&TE critical fo ID # 106276 101369 SN 7600 SN 771	calibration) Cal Date(Ca 12-May-20 (C 12-May-20 (C 30-Nov-20(C 10-Feb-20(C	librated by, Certifica CTTL, No.J20X0296 CTTL, No.J20X0296 TTL-SPEAG,No.Z2 TTL-SPEAG,No.Z2	ate No.) 85) 85) 20-60421) 20-60017)	Schedu	led Calibration May-21 May-21 Nov-21
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4	(M&TE critical fo ID # 106276 101369 SN 7600	Cal Date(Ca 12-May-20 (C 12-May-20 (C 30-Nov-20(C 10-Feb-20(C Cal Date(Cal 25-Feb-20 (C	librated by, Certific TTL, No.J20X0296 TTL, No.J20X0296 TTL-SPEAG,No.Z2	ate No.) 35) 20-60421) 20-60017) ate No.) 16)	Schedu	led Calibration May-21 May-21 Nov-21 Feb-21
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	(M&TE critical fo ID # 106276 101369 SN 7600 SN 771 ID # MY49071430	calibration) Cal Date(Ca 12-May-20 (C 12-May-20 (C 30-Nov-20(C 10-Feb-20(C Cal Date(Cal 25-Feb-20 (C 10-Feb-20 (C	librated by, Certific CTTL, No.J20X0296 CTTL, No.J20X0296 TTL-SPEAG,No.Z2 TTL-SPEAG,No.Z2 ibrated by, Certifica	ate No.) 35) 20-60421) 20-60017) ate No.) 16)	Schedu	led Calibration May-21 May-21 Nov-21 Feb-21 Jed Calibration Feb-21
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	(M&TE critical fo ID # 106276 101369 SN 7600 SN 771 ID # MY49071430 MY46110673	r calibration) Cal Date(Ca 12-May-20 (C 30-Nov-20(C 10-Feb-20(C Cal Date(Cal 25-Feb-20 (C 10-Feb-20 (C	librated by, Certifica CTTL, No.J20X0296 CTTL, No.J20X0296 TTL-SPEAG,No.Z2 TTL-SPEAG,No.Z2 ibrated by, Certifica CTTL, No.J20X005 CTTL, No.J20X005	ate No.) 35) 20-60421) 20-60017) ate No.) 16)	Schedu	led Calibration May-21 May-21 Nov-21 Feb-21 Juled Calibration Feb-21 Feb-21
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	(M&TE critical fo ID # 106276 101369 SN 7600 SN 771 ID # MY49071430 MY46110673 Name	r calibration) Cal Date(Ca 12-May-20 (C 12-May-20 (C 30-Nov-20(C 10-Feb-20(C Cal Date(Cal 25-Feb-20 (C 10-Feb-20 (C 10-Feb-20 (C Fun SAR Te	librated by, Certifica CTTL, No.J20X0296 CTTL, No.J20X0296 TTL-SPEAG,No.Z2 TTL-SPEAG,No.Z2 ibrated by, Certifica CTTL, No.J20X0057 CTTL, No.J20X0057	ate No.) 35) 20-60421) 20-60017) ate No.) 16)	Schedu	led Calibration May-21 May-21 Nov-21 Feb-21 Juled Calibration Feb-21 Feb-21
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lossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "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%.

Certificate No: Z21-60019

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Measurement Conditions

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

 DASY Version
 DASY52
 V52.10.4

 Extrapolation
 Advanced Extrapolation

 Phantom
 Triple Flat Phantom 5.1C

 Distance Dipole Center - TSL
 10 mm
 with Spacer

 Zoom Scan Resolution
 dx, dy, dz = 5 mm
 Frequency
 1900 MHz ± 1 MHz

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.1 ± 6 %	1.38 mlho/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	9.85 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	39.8 W/kg ± 18.8 % (k=	
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	5.05 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	20.3 W/kg ± 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	53.5Ω+ 7.88jΩ		
Return Loss	- 21.6dB		

General Antenna Parameters and Design

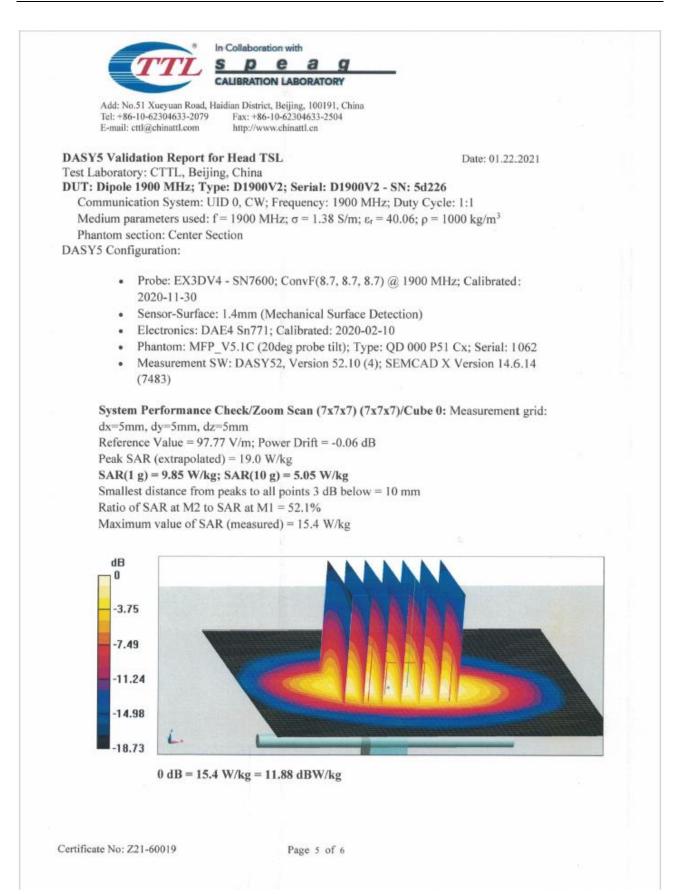
Electrical Delay (one direction)	1.102 ns
----------------------------------	----------

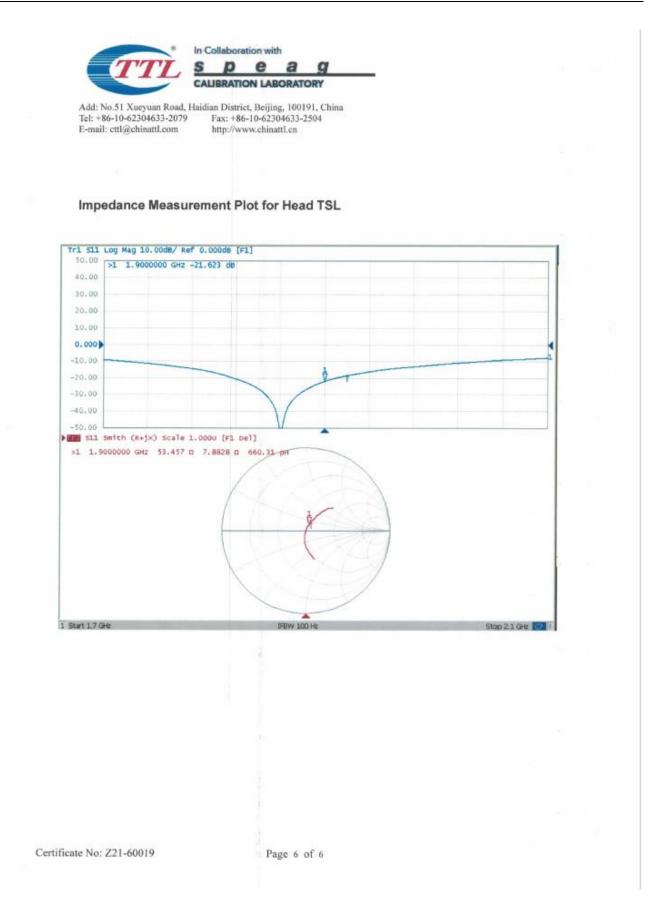
After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by		SPEAG	
lasta Nov 721 60010	D		
icate No: Z21-60019	Page 4 of 6		





Extended Dipole Calibrations

Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

Head-1900						
Date of	Return-loss (dB)	Dolto (9())	Real Impedance	Delta	Imaginary	Delta
measurement	Return-IOSS (ub)	Delta (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2021-01-22	-21.6		53.5		7.88	
2022-01-17	-22.4	3.70	53.9	0.4	7.35	0.53
2023-01-15	-22.1	2.31	53.6	0.1	7.46	0.42

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 50hm of prior calibration. Therefore the verification result should support extended calibration.

1.5. D2450V2 Dipole Calibration Certificate

		ON LABORATORY	Hac-MRA	GN	名 S 校准 CALIBRA	TION
Tel: +86-10-62304633	5-2079 Fax: +8	ict, Beijing, 100191, China 6-10-62304633-2504	The Anderson		CNAS LO	
E-mail: cttl@chinattl.	com nup://w	ww.chinattl.cn	Certificate No:	Z21-600	20	
Client	DTICICAT	E LA LA LA		22.2	P NA	
CALIBRATION CE	RIFICAT		12000	and the last		-
Dbject	D2450V	2 - SN: 1009				
Calibration Procedure(s)	FF-Z11- Calibrat	003-01 ion Procedures for di	ipole validation kits	s		
Calibration date:	COLUMN STATES	25, 2021				
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This calibration Certificate d	ocuments the t	raceability to nationa	al standards, which	an realize ti	ven on the follow	wing
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ages and are part of the bei	uncate.					
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All calibrations have been humidity<70%.	conducted in t		ry facility: environ	nment temp	erature(22±3)℃	and
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Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "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%.

Certificate No: Z21-60020

Page 2 of 6



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 http://www.chinattl.cn

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
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	2450 MHz ± 1 MHz	

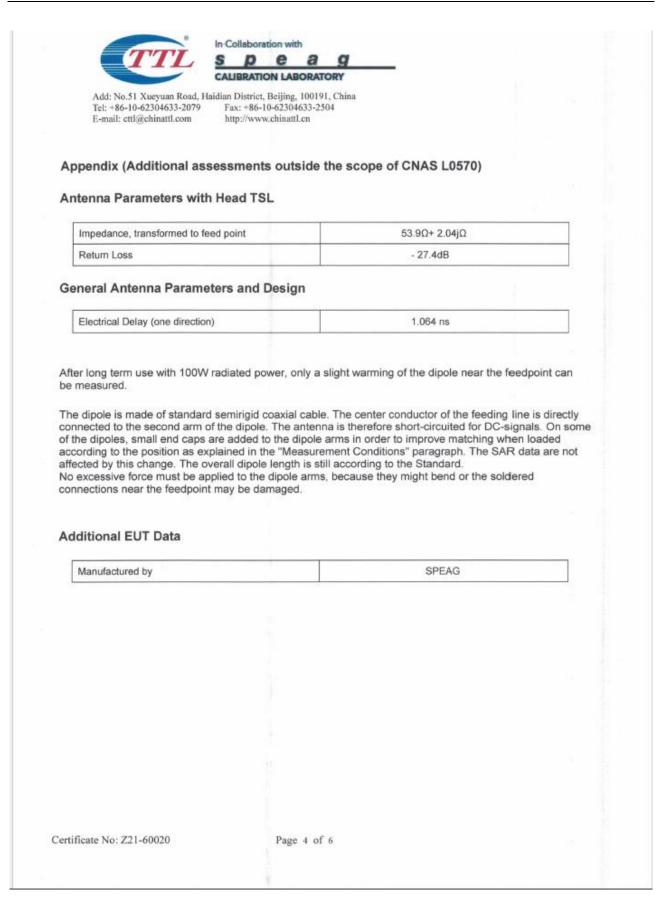
Head TSL parameters

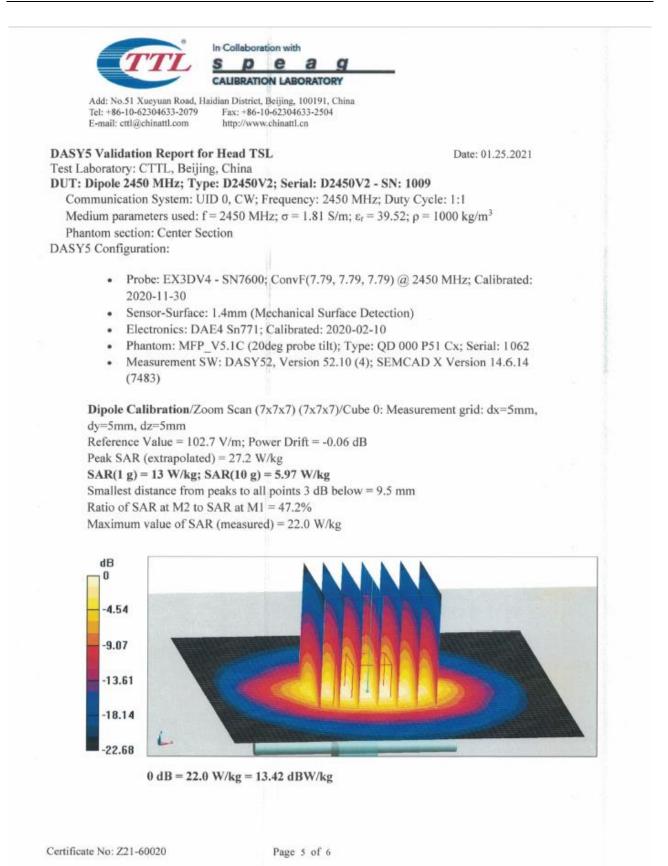
The following parameters and calculations were applied.

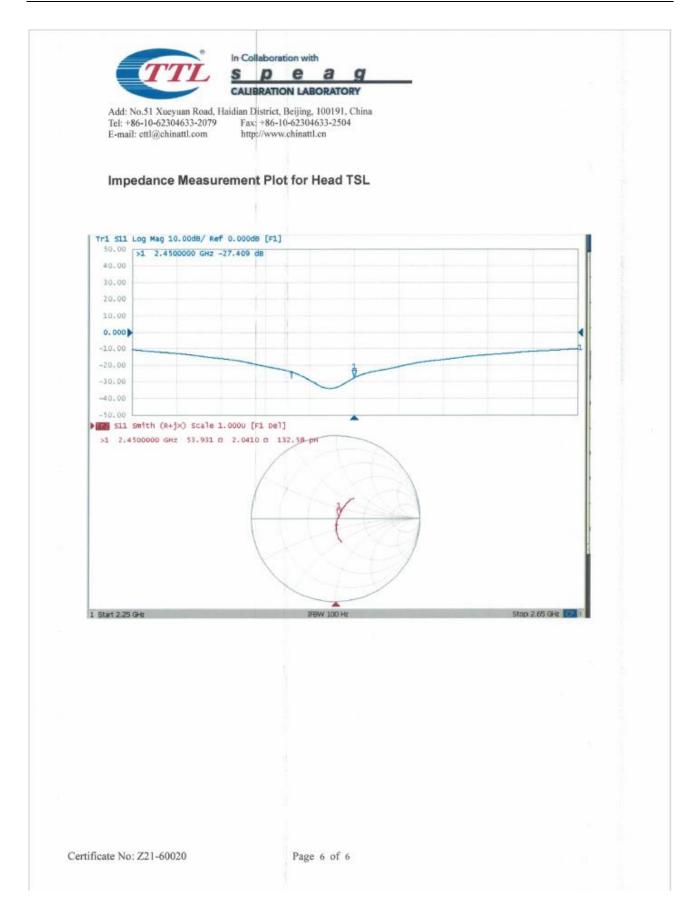
1	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.5 ± 6 %	1.81 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.0 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.97 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.9 W/kg ± 18.7 % (k=2)







Extended Dipole Calibrations

Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

Head-2450						
Date of	Poturn loop (dP)	Dolto (9/)	Real Impedance	Delta	Imaginary	Delta
measurement	Return-loss (dB)	Delta (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2021-01-25	-27.4		53.9		2.04	
2022-01-17	-27.9	1.82	53.5	0.4	2.34	0.3
2023-01-15	-27.3	-0.36	53.7	0.2	2.16	0.12

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 50hm of prior calibration. Therefore the verification result should support extended calibration.

1.6. D2600V2 Dipole Calibration Certificate

Tel: +86-10-62304633-2 E-mail: ettl@chinattl.co	2079 Fax: +80-	A, Beijing, 100191, China -10-62304633-2504 ww.chinattl.en Certificate No: Z21-	-60021
Client HTW		Certificato ito:	
CALIBRATION CER	RTIFICATE		
Dbject	D2600V2	2 - SN: 1150	
Calibration Procedure(s)	FF-Z11-0 Calibratio	003-01 on Procedures for dipole validation kits	
Calibration date:	January	25, 2021	1111
All calibrations have been of	conducted in a	he closed laboratory facility: environment	
All calibrations have been of humidity<70%. Calibration Equipment used (or calibration)	5
humidity<70%. Calibration Equipment used (or calibration) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibratio
humidity<70%.	M&TE critical fo	or calibration)	5
humidity<70%. Calibration Equipment used (Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4	M&TE critical fo ID # 106276 101369 SN 7600 SN 771	Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965) 30-Nov-20(CTTL-SPEAG,No.Z20-60421) 10-Feb-20(CTTL-SPEAG,No.Z20-60017)	Scheduled Calibratio May-21 May-21 Nov-21 Feb-21
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humidity<70%. Calibration Equipment used (Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C Network Analyzer E5071C	M&TE critical fo ID # 106276 101369 SN 7600 SN 771 ID # MY49071430 MY46110673 Name	Cal Date(Calibrated by, Certificate No.) 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965) 30-Nov-20(CTTL-SPEAG,No.Z20-60421) 10-Feb-20(CTTL-SPEAG,No.Z20-60017) Cal Date(Calibrated by, Certificate No.) 25-Feb-20 (CTTL, No.J20X00516) 10-Feb-20 (CTTL, No.J20X00515) Function	Scheduled Calibratio May-21 May-21 Nov-21 Feb-21 Scheduled Calibratio Feb-21 Feb-21
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Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "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.

DASY52	V52.10.4	
	V52.10.4	
Advanced Extrapolation		
Triple Flat Phantom 5.1C		
10 mm	with Spacer	
dx, dy, dz = 5 mm		
2600 MHz ± 1 MHz		
	Triple Flat Phantom 5.1C 10 mm dx, dy, dz = 5 mm	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.7 ± 6 %	1.97 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

SAR result with Head TSL

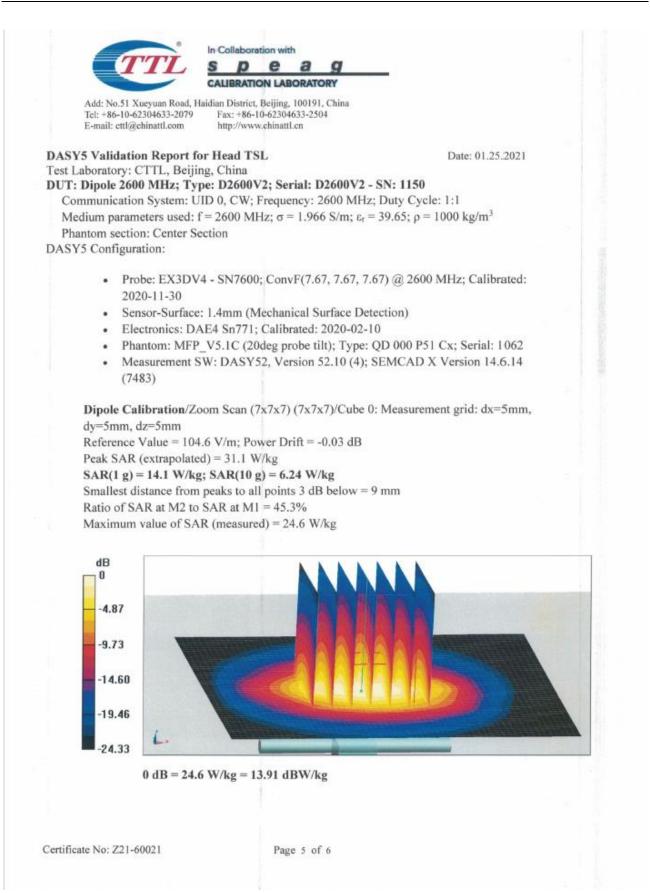
SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	14.1 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	56.5 W/kg ± 18.8 % (k=2)	
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	6.24 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	25.0 W/kg ± 18.7 % (k=2)	

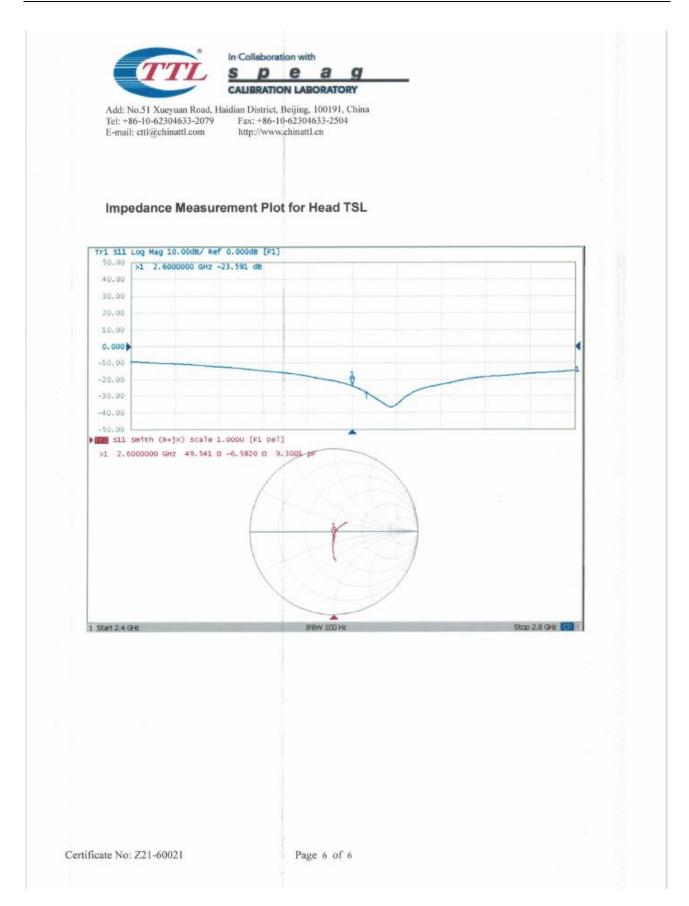
Certificate No: Z21-60021

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CALIBRA	TION LABORATORY	
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Appendix(Additional assessmen		cope of CNAS L0570)
Impedance, transformed to feed point		49.5Ω- 6.58jΩ
Return Loss		- 23.6dB
General Antenna Parameters and Electrical Delay (one direction)	a Design	1.047 ns
Electrical Delay (one direction)		1.047 115
be measured. The dipole is made of standard semirigion connected to the second arm of the dipole of the dipoles, small end caps are added according to the position as explained in affected by this change. The overall dipo No excessive force must be applied to the	d coaxial cable. The ble. The antenna is d to the dipole arms n the "Measuremen ole length is still act he dipole arms, bed	
be measured. The dipole is made of standard semirigion connected to the second arm of the dipole of the dipoles, small end caps are added according to the position as explained in affected by this change. The overall dipo No excessive force must be applied to the connections near the feedpoint may be o	d coaxial cable. The ble. The antenna is d to the dipole arms n the "Measuremen ole length is still act he dipole arms, bed	e center conductor of the feeding line is dire therefore short-circuited for DC-signals. On in order to improve matching when loaded t Conditions" paragraph. The SAR data are cording to the Standard.
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Extended Dipole Calibrations

Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

Head-2600						
Date of	Return-loss (dB)	Dolto (9/)	Real Impedance	Delta	Imaginary	Delta
measurement		Delta (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2022-01-25	-23.6		49.5		-6.58	
2022-01-17	-24.0	1.69	49.1	0.4	-6.03	0.55
2023-01-15	-23.8	0.85	49.3	0.2	-6.33	0.25

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 50hm of prior calibration. Therefore the verification result should support extended calibration.