1.1.1.1. D750V3 Dipole Calibration Certificate

E-mail: cttl@chinattl.com		Certificate No: Z21-60010	6
Client HTW	TIFICATE		
ALIDIGATION	13.04		
bject	D750V3 -	SN: 1180	
alibration Procedure(s)	FF-Z11-0	02.01	
alibration Procedure(o)	Calibratio	on Procedures for dipole validation kits	
			3
alibration date:	January 2	22, 2021 aceability to national standards, which realize the	
All calibrations have been	conducted in th	he closed laboratory lacing. crimental	
numidity<70%.		ne closed laboratory facility: environment tempe or calibration)	
numidity<70%. Calibration Equipment used (M&TE critical fo	r calibration)	eduled Calibration
numidity<70%. Calibration Equipment used (Primary Standards		Cal Date(Calibrated by, Certificate No.) Sch 12-May-20 (CTTL, No.J20X02965)	eduled Calibration May-21
numidity<70%. Calibration Equipment used (Primary Standards Power Meter NRP2	M&TE critical fo ID # 106276- 101369	Cal Date(Calibrated by, Certificate No.) Sch 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965)	eduled Calibration
numidity<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(Calibrated by, Certificate No.) Sch 12-May-20 (CTTL, No.J20X02965) 12-May-20 (CTTL, No.J20X02965) 30-Nov-20(CTTL-SPEAG,No.Z20-60421)	eduled Calibration May-21 May-21
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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 Zhao Jing	Cal Date(Calibrated by, Certificate No.) Sch 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.) Sch 25-Feb-20 (CTTL, No.J20X00516) 10-Feb-20 (CTTL, No.J20X00516) 10-Feb-20 (CTTL, No.J20X00516) Sch SAR Test Engineer SAR Test Engineer	eduled Calibration May-21 May-21 Nov-21 Feb-21 Feb-21 Feb-21 Feb-21 Signature



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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



In Collaboration with 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



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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

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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rtificate No: Z21-60016	1	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

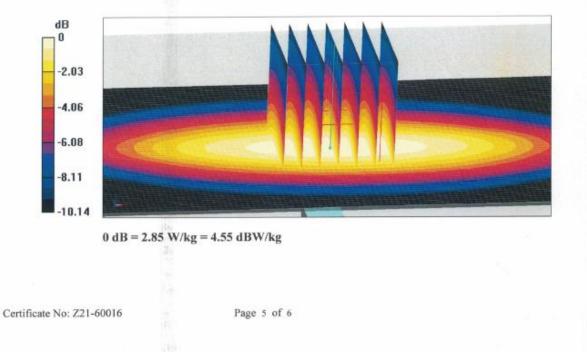
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 750 MHz; $\sigma = 0.905$ S/m; $\varepsilon_r = 42.25$; $\rho = 1000$ kg/m3 Phantom section: Right Section

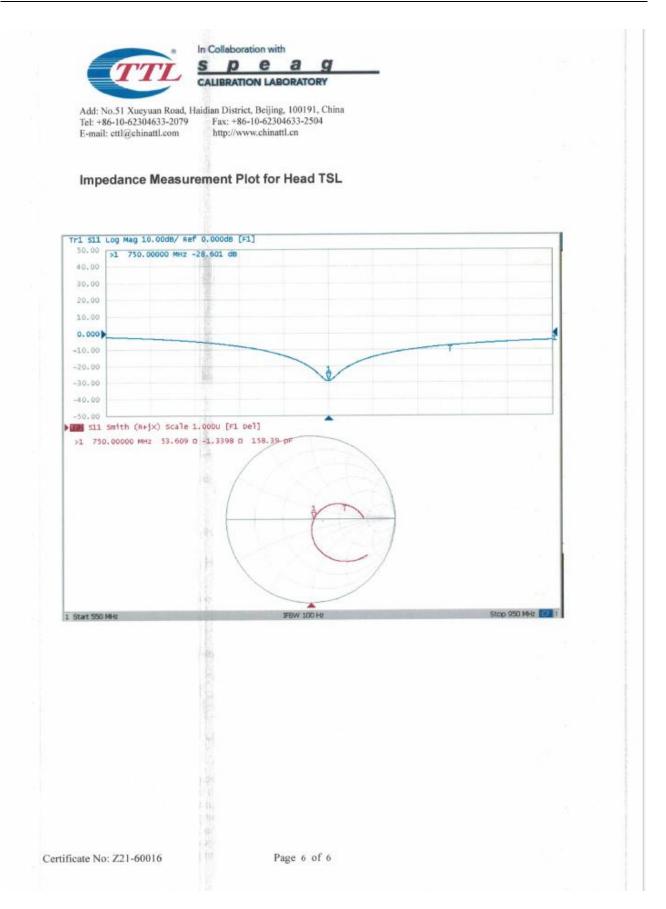
DASY5 Configuration:

- 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

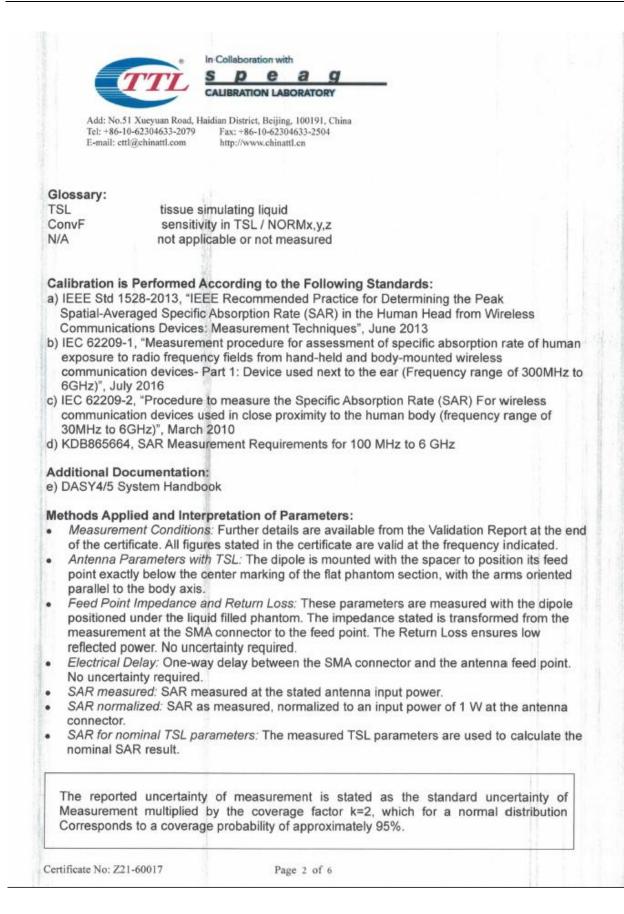
Reference Value = 54.99 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 3.25 W/kg SAR(1 g) = 2.13 W/kg; SAR(10 g) = 1.41 W/kg Smallest distance from peaks to all points 3 dB below = 22.7 mm Ratio of SAR at M2 to SAR at M1 = 65.6% Maximum value of SAR (measured) = 2.85 W/kg





1.2. D835V2 Dipole Calibration Certificate

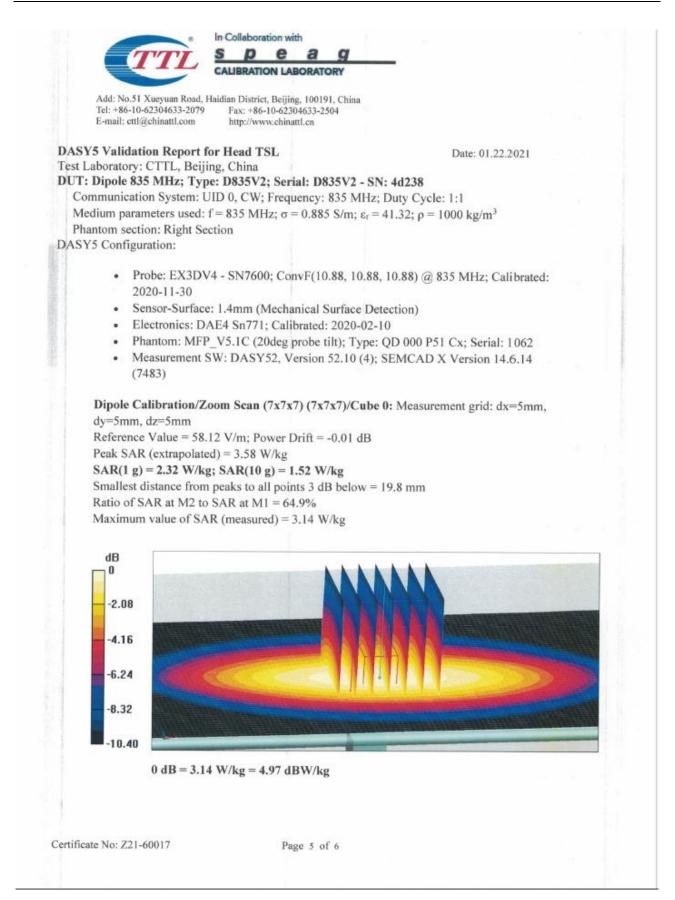
Tel: +86-10-62304 E-mail: cttl@china	ttl.com http://	+86-10-62304633-2504	
Client HTW		A DECEMBER OF	1-60017
March 100 March	EDTIFICA	T	
CALIBRATION C	ERTIFICA	IE	aver to said
Object	D835\	/2 - SN: 4d238	
Calibration Procedure(s)			
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	Calibra	ation Procedures for dipole validation kits	
Calibration date:	Januar	ry 22, 2021	
251 700 000 0.55 MM 54		and annual to be an an an an and an and	
	asurements and	traceability to national standards, which read the uncertainties with confidence probability	
All calibrations have been	a conducted in	the closed laboratory facility environment	tomporature/22+21% and
humidity<70%.		the closed laboratory facility: environment for calibration)	temperature(22±3)°C and
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numidity<70%. Calibration Equipment used Primary Standards	ID#	for calibration) Cal Date(Calibrated by, Certificate No.)	
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4	ID # 106276 101369 SN 7600	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)	Scheduled Calibration May-21 May-21 Nov-21
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numidity<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
numidity<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
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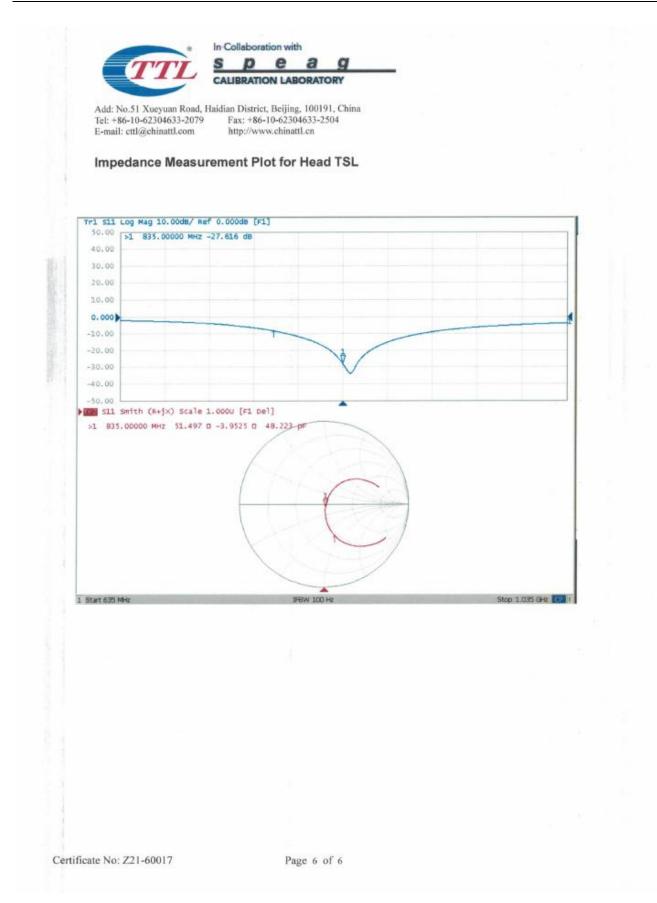


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TTT	pe	ag			
	ALIBRATION LA	BORATORY			
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DASY system configuration, as fa	ir as not given o				
DASY Version	267.727.73	DASY52			V52.10.4
Extrapolation	Advan	ced Extrapolation			
Phantom	Triple	Flat Phantom 5.1C			
Distance Dipole Center - TSL		15 mm			with Spacer
Zoom Scan Resolution	dx,	dy, dz = 5 mm			
Frequency	835	MHz ± 1 MHz			
lead TSL parameters The following parameters and cal	culations were a	pplied. Temperature	Permitti	vity	Conductivity
Nominal Head TSL parameter	s	22.0 °C	41.5		0.90 mho/m
Measured Head TSL paramete		(22.0 ± 0.2) °C	41.3 ± 0	3 %	0.89 mho/m ± 6 %
	78 78 8 81				
	e during test	<1.0 °C			
Head TSL temperature chang	e during test	<1.0 °C			
		<1.0 °C	ion		
Head TSL temperature chang AR result with Head TSL					2.32 W/kg
Head TSL temperature chang AR result with Head TSL SAR averaged over 1 cm ³ (1	g) of Head TSL	Condit	put power	9.39	2.32 W/kg W/kg ± 18.8 % (<i>k</i> =2)
Head TSL temperature chang AR result with Head TSL SAR averaged over 1 cm ³ (1 SAR measured	g) of Head TSL ameters	Condit 250 mW in normalize	put power d to 1W	9.39	
Head TSL temperature chang AR result with Head TSL SAR averaged over 1 cm ³ (1 SAR measured SAR for nominal Head TSL para	g) of Head TSL ameters	Condit 250 mW in normalize	put power d to 1W ion	9.39	

Certificate No: Z21-60017

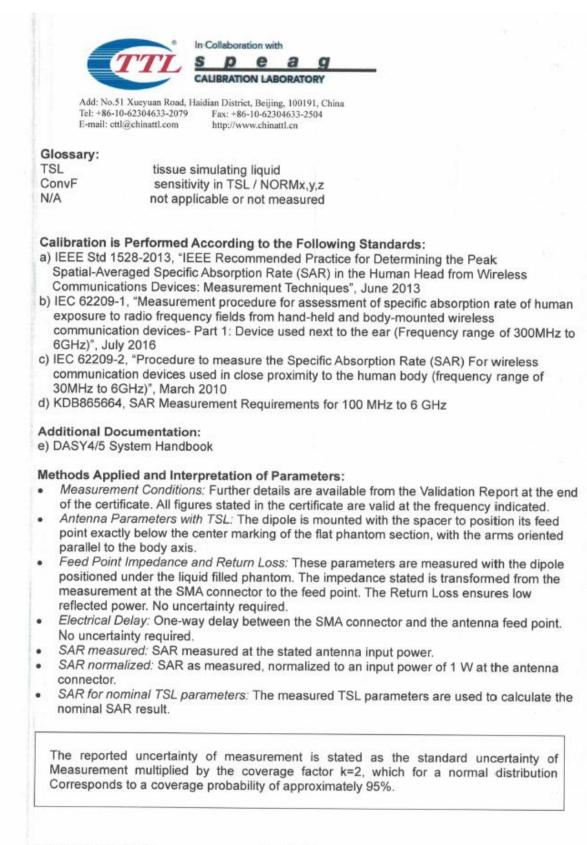
Electrical Delay (one direction) 1.298 ns After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint car be measured. The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is direct connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On s 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 nuffected 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.
Antenna Parameters with Head TSL Impedance, transformed to feed point 51.50-3.95j0 Return Loss -27.6dB General Antenna Parameters and Design Electrical Delay (one direction) 1.298 ns After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint car be measured. The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is direct connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On s 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 notificated 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 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 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 by this change. The overall dipole length is still according to the Standard. Additional EUT Data
Impedance, transformed to feed point 51.5Ω- 3.95jΩ Return Loss - 27.6dB General Antenna Parameters and Design Image: Comparison of the dipole of the di
Return Loss - 27.6dB General Antenna Parameters and Design Electrical Delay (one direction) 1.298 ns After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint car be measured. The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is direct connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On s 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
General Antenna Parameters and Design Electrical Delay (one direction) 1.298 ns After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint car be measured. The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is direct connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On s 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
Electrical Delay (one direction) 1.298 ns After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint car be measured. The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is direct connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On s 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 notificated 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
After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint car be measured. The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is direct connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On s 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 nu 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.
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is direct connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On s 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 no 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.
Manufactured by SPEAG





1.3. D1750V2 Dipole Calibration Certificate

Client HTW					
		Certificate N	lo: Z21	-60018	
CALIBRATION C	ERTIFICA	TE			
				and the second	
Object	D175	0V2 - SN: 1164			
Calibration Procedure(s)	FF-Z	1-003-01			
	Calibr	ation Procedures for dipole validation	on kits		100
Calibration date:	lanus	ry 22, 2021		and the second second	
	Janua	IIY 22, 2021			
This calibration Certificate	documents the	traceability to national standards,	which rea	alize the physical	units of
		d the uncertainties with confidence			
pages and are part of the c	ertificate.				1
All collibrations, have been					
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	n conducted in	the closed laboratory facility: en	vironment	temperature(22±3	3)°C and
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numidity<70%.			ivironment	temperature(22±3	3)°C and
uumidity<70%. Calibration Equipment used	d (M&TE critical	for calibration)		temperature(22±:	3)℃ and
uumidity<70%. Calibration Equipment used Primary Standards	ID#	for calibration) Cal Date(Calibrated by, Certifica	ate No.)	Scheduled Cali	bration
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2	ID #	for calibration) Cal Date(Calibrated by, Certifica 12-May-20 (CTTL, No.J20X0296	ate No.) 5)	Scheduled Cali May-2	bration 1
uumidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A	ID # 106276 101369	for calibration) Cal Date(Calibrated by, Certifica 12-May-20 (CTTL, No.J20X0296 12-May-20 (CTTL, No.J20X0296	ate No.) 55) 55)	Scheduled Cali May-2 May-2	bration 1
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umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4	ID # 106276 101369 SN 7600	for calibration) Cal Date(Calibrated by, Certifica 12-May-20 (CTTL, No.J20X0296 12-May-20 (CTTL, No.J20X0296	ate No.) 55) 55) 0-60421)	Scheduled Cali May-2 May-2	bration 1 1 1
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aumidity<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, Certifica 12-May-20 (CTTL, No.J20X0296 12-May-20 (CTTL, No.J20X0296 30-Nov-20(CTTL-SPEAG,No.Z20 10-Feb-20(CTTL-SPEAG,No.Z20 Cal Date(Calibrated by, Certificat 25-Feb-20 (CTTL, No.J20X00516	ate No.) 55) 55) 0-60421) 0-60017) te No.) 6)	Scheduled Cali May-2 May-2 Nov-2 Feb-21	bration 1 1 1 1 1 bration
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aumidity<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, Certifica 12-May-20 (CTTL, No.J20X0296 12-May-20 (CTTL, No.J20X0296 30-Nov-20(CTTL-SPEAG,No.Z20 10-Feb-20(CTTL-SPEAG,No.Z20 Cal Date(Calibrated by, Certificat 25-Feb-20 (CTTL, No.J20X00510 10-Feb-20 (CTTL, No.J20X00510	ate No.) 55) 55) 0-60421) 0-60017) te No.) 6)	Scheduled Cali May-2 May-2 Nov-2 Feb-2 Scheduled Cali Feb-2 Feb-2	bration 1 1 1 1 1 bration 1
numidity<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, Certifica 12-May-20 (CTTL, No.J20X0296 12-May-20 (CTTL, No.J20X0296 30-Nov-20(CTTL-SPEAG,No.Z20 10-Feb-20(CTTL-SPEAG,No.Z20 Cal Date(Calibrated by, Certificat 25-Feb-20 (CTTL, No.J20X00516 10-Feb-20 (CTTL, No.J20X00516	ate No.) 55) 55) 0-60421) 0-60017) te No.) 6)	Scheduled Cali May-2 May-2 Nov-2 Feb-2 Scheduled Cali Feb-2	bration 1 1 1 1 1 bration 1
numidity<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, Certifica 12-May-20 (CTTL, No.J20X0296 12-May-20 (CTTL, No.J20X0296 30-Nov-20(CTTL-SPEAG,No.Z20 10-Feb-20(CTTL-SPEAG,No.Z20 Cal Date(Calibrated by, Certificat 25-Feb-20 (CTTL, No.J20X00510 10-Feb-20 (CTTL, No.J20X00510	ate No.) 55) 55) 0-60421) 0-60017) te No.) 6)	Scheduled Cali May-2 May-2 Nov-2 Feb-2 Scheduled Cali Feb-2 Feb-2	bration 1 1 1 1 1 bration 1
aumidity<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, Certifica 12-May-20 (CTTL, No.J20X0296 12-May-20 (CTTL, No.J20X0296 30-Nov-20(CTTL-SPEAG,No.Z20 10-Feb-20(CTTL-SPEAG,No.Z20 Cal Date(Calibrated by, Certificat 25-Feb-20 (CTTL, No.J20X00516 10-Feb-20 (CTTL, No.J20X00516	ate No.) 55) 55) 0-60421) 0-60017) te No.) 6)	Scheduled Cali May-2 May-2 Nov-2 Feb-2 Scheduled Cali Feb-2 Feb-2	bration 1 1 1 1 1 bration 1
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Certificate No: Z21-60018

Add: No.51 Xueyuan Road, Haidian Dis	strict, Beijin				
	+86-10-623(/www.china				
asurement Conditions					
DASY system configuration, as far as no DASY Version	ot given or				100 10 1
110000 90000		DASY52			V52.10.4
Extrapolation		ed Extrapolation			
Phantom	Triple F	lat Phantom 5.1C	-		
Distance Dipole Center - TSL		10 mm)	with Spacer
and a second					
Zoom Scan Resolution	dx, d	dy, dz = 5 mm			
Zoom Scan Resolution Frequency ad TSL parameters The following parameters and calculation	1750	0 MHz ± 1 MHz	Permitti	vity	Conductivity
Frequency ad TSL parameters	1750	0 MHz ± 1 MHz	Permitti	vity	Conductivity
Frequency ad TSL parameters	1750	0 MHz ± 1 MHz	Permittin 40.1	vity	Conductivity 1.37 mho/m
Frequency ad TSL parameters he following parameters and calculation	1750	0 MHz ± 1 MHz oplied. Temperature			1.37 mho/m
Frequency ad TSL parameters he following parameters and calculation Nominal Head TSL parameters Measured Head TSL parameters Head TSL temperature change durin	1750	0 MHz ± 1 MHz oplied. Temperature 22.0 °C	40.1		1.37 mho/m
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Frequency ad TSL parameters The following parameters and calculation Nominal Head TSL parameters Measured Head TSL parameters Head TSL temperature change durint R result with Head TSL SAR averaged over 1 cm ³ (1 g) of He SAR for nominal Head TSL parameters	1750	0 MHz ± 1 MHz pplied. Temperature 22.0 °C (22.0 ± 0.2) °C <1.0 °C Condit 250 mW inp normalize	40.1 39.8 ± 6 ion put power d to 1W	3 %	1.37 mho/m 1.37 mho/m ± 6 9.13 W/kg
Frequency ad TSL parameters he following parameters and calculation Nominal Head TSL parameters Measured Head TSL parameters Head TSL temperature change durint R result with Head TSL SAR averaged over 1 cm ³ (1 g) of Head SAR for nominal Head TSL parameters SAR averaged over 10 cm ³ (10 g) of	1750	0 MHz ± 1 MHz pplied. Temperature 22.0 °C (22.0 ± 0.2) °C <1.0 °C Condit 250 mW in normalized Condit	40.1 39.8 ± 6 ion put power d to 1W ion	3 %	1.37 mho/m ± 6 9.13 W/kg W/kg ± 18.8 % (k=
Frequency ad TSL parameters The following parameters and calculation Nominal Head TSL parameters Measured Head TSL parameters Head TSL temperature change durint R result with Head TSL SAR averaged over 1 cm ³ (1 g) of He SAR for nominal Head TSL parameters	1750	0 MHz ± 1 MHz pplied. Temperature 22.0 °C (22.0 ± 0.2) °C <1.0 °C Condit 250 mW inp normalize	40.1 39.8 ± 6 ion put power d to 1W ion put power	3%	1.37 mho/m 1.37 mho/m ± 6 9.13 W/kg

Certificate No: Z21-60018



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

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

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

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

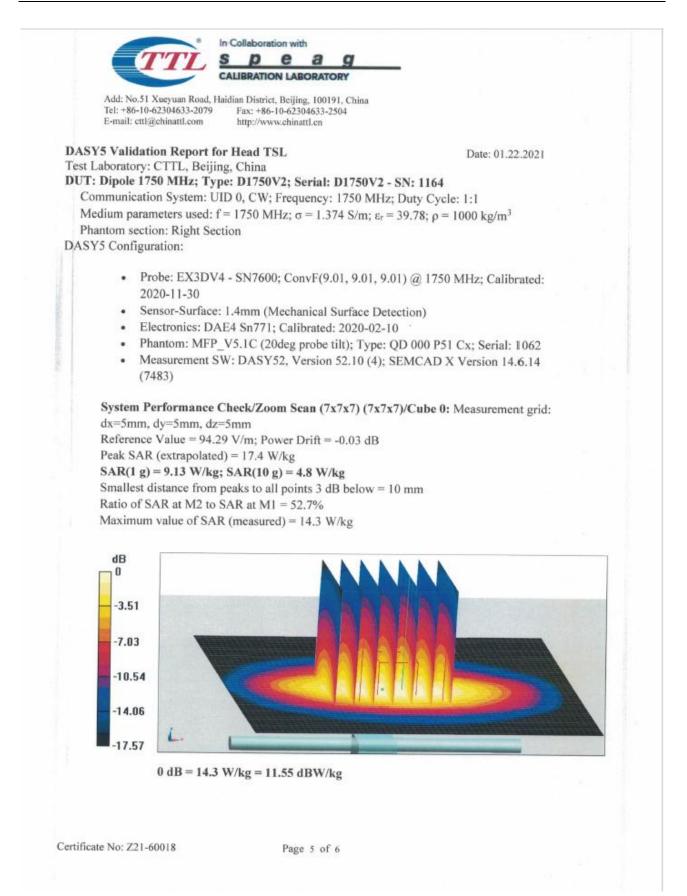
Electrical Delay (one direction)	1.124 ns
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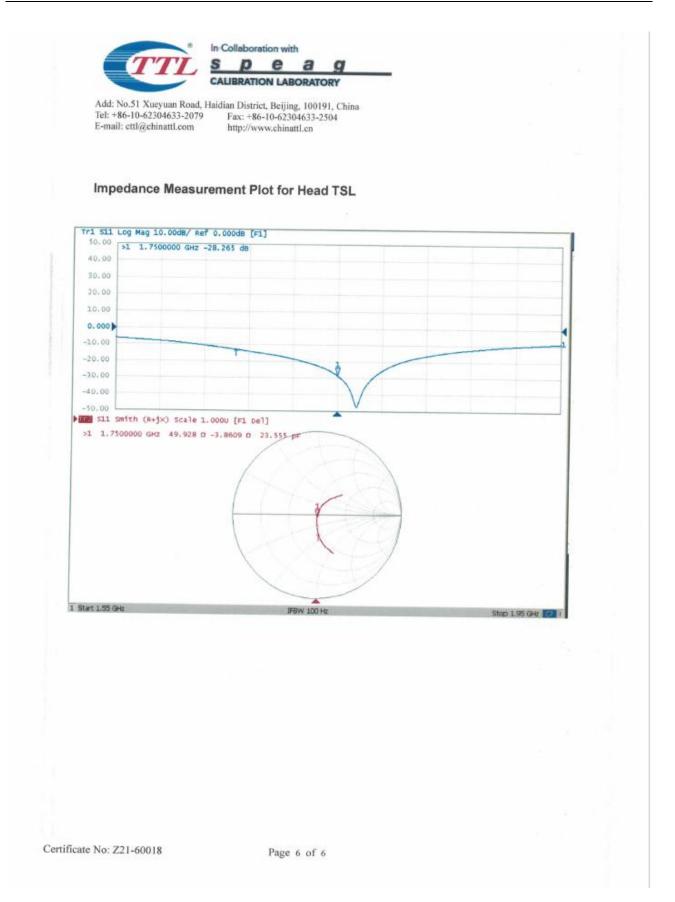
After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded 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		





1.4. D1900V2 Dipole Calibration Certificate

E-mail: cttl@chinattl			hattl.cn			
Client HTW	and the second se		Certificate No:	Z21-	60019	-
ALIBRATION CE	RTIFICAT	E				
bject	D1900\	/2 - SN	l: 5d226		100	
alibration Procedure(s)	FF-Z11 Calibra		1 ocedures for dipole validation k	its		
alibration date:	January	122,2	021		C. C. M. N	
numidity<70%.			osed laboratory facility: enviro	onment t	temperature(22	2±3)℃ and
numidity<70%. Calibration Equipment used	conducted in	or cali			Scheduled C	alibration
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2	I (M&TE critical f	or cali Cal	Dration) Date(Calibrated by, Certificate May-20 (CTTL, No.J20X02965)	No.)	Scheduled C May	alibration
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A	I Conducted in (M&TE critical f ID # 106276 101369	Cal Cal 12-N 12-N	Date(Calibrated by, Certificate May-20 (CTTL, No.J20X02965) May-20 (CTTL, No.J20X02965)	No.)	Scheduled C May May	alibration
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numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4	I (M&TE critical f I (M&TE critical f 106276 101369 SN 7600 SN 771	Cal 12-M 12-M 30-M 10-F	Date(Calibrated by, Certificate May-20 (CTTL, No.J20X02965) May-20 (CTTL, No.J20X02965) Nov-20(CTTL-SPEAG,No.Z20-6 eb-20(CTTL-SPEAG,No.Z20-6	No.) 60421) 60017)	Scheduled C May May Nor	alibration -21 -21 v-21 v-21
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4	I Conducted in I (M&TE critical f 106276 101369 SN 7600 SN 771 ID # ID #	Cali 12-M 12-M 30-M 10-F Cal 0 25-I	Date(Calibrated by, Certificate May-20 (CTTL, No.J20X02965) May-20 (CTTL, No.J20X02965) Nov-20(CTTL-SPEAG,No.Z20-6	No.) 60421) 60017)	Scheduled C May May Nov Feb Scheduled C	alibration -21 -21 v-21 v-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=2)
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

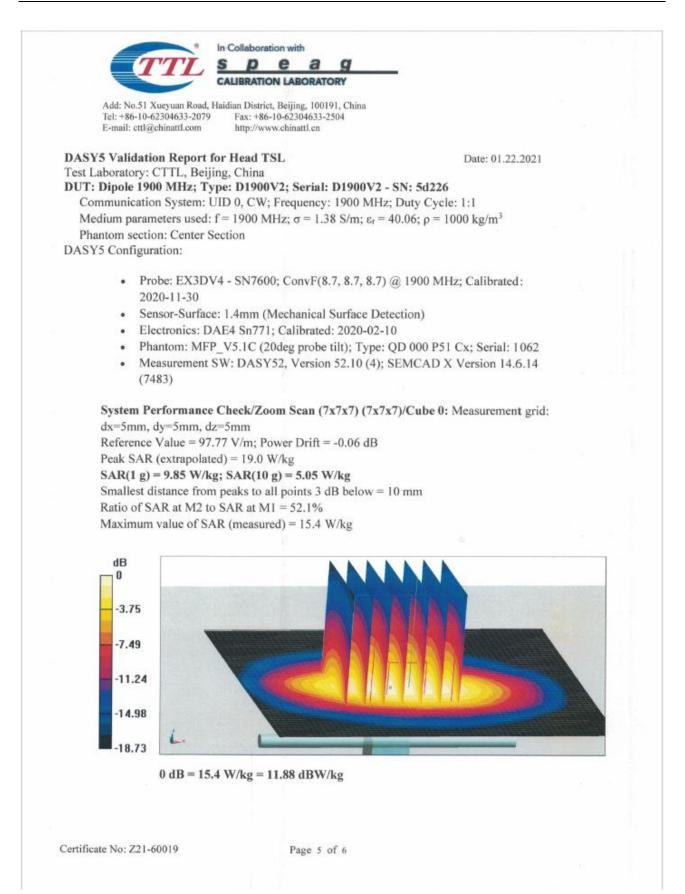
Electrical Delay (one direction)	1.102 ns
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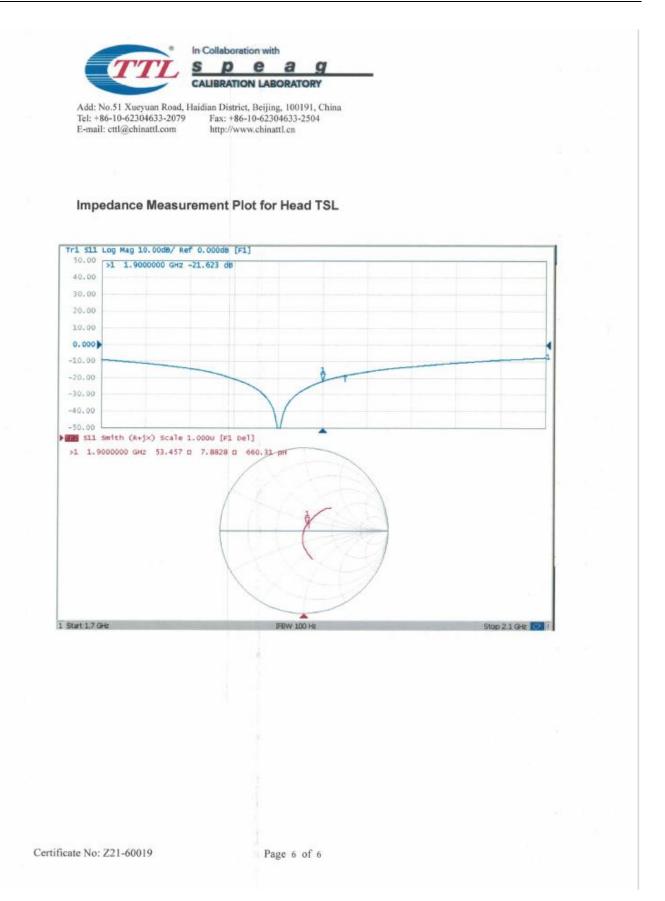
After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded 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	
icate No: Z21-60019	Page 4 of 6		





1.5. D2450V2 Dipole Calibration Certificate

	ILIBRATION IAS L0570
Client HTW Certificate No: Z21-60020 CALIBRATION CERTIFICATE Object D2450V2 - SN: 1009 Calibration Procedure(s) FF-Z11-003-01 Calibration Procedures for dipole validation kits	
Deleter D2450V2 - SN: 1009 Calibration Procedure(s) FF-Z11-003-01 Calibration Procedures for dipole validation kits	
Dbject D2450V2 - SN: 1009 Calibration Procedure(s) FF-Z11-003-01 Calibration Procedures for dipole validation kits	
Calibration Procedure(s) FF-Z11-003-01 Calibration Procedures for dipole validation kits	
Calibration Procedures for dipole validation kits	
Calibration Procedures for dipole validation kits	
Calibration date: January 25, 2021	
This calibration Certificate documents the traceability to national standards, which realize the physica	al units of
This calibration Certificate documents the traceability to halional standards, which realize the physics	following
neasurements(SI). The measurements and the uncertainties with confidence probability are given on the	tonowing
pages and are part of the certificate.	
	and and
All calibrations have been conducted in the closed laboratory facility: environment temperature(22	±3)°C and
numidity<70%.	
Calibration Equipment used (M&TE critical for calibration)	
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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



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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	2450 MHz ± 1 MHz	

Head TSL parameters

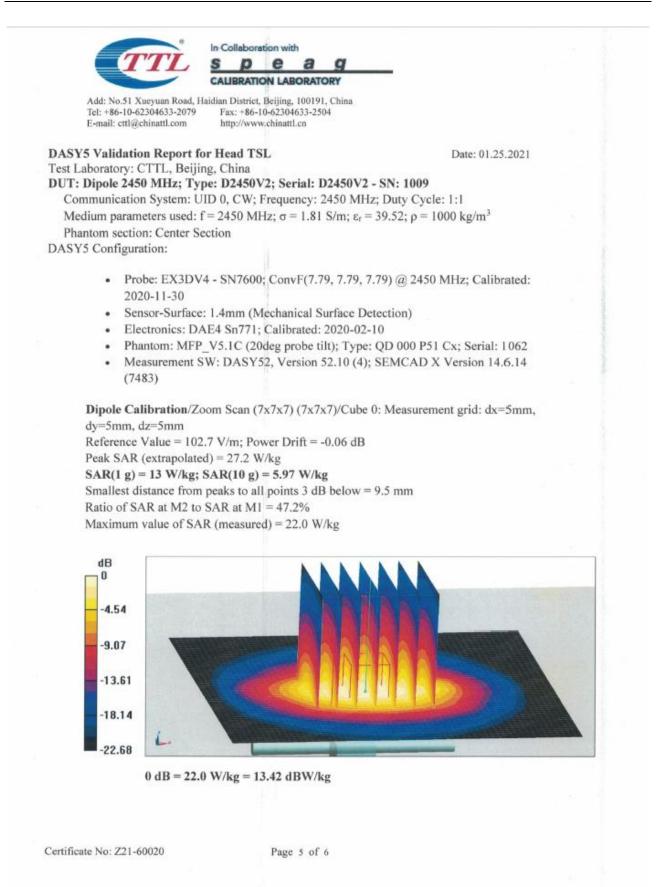
The following parameters and calculations were applied.

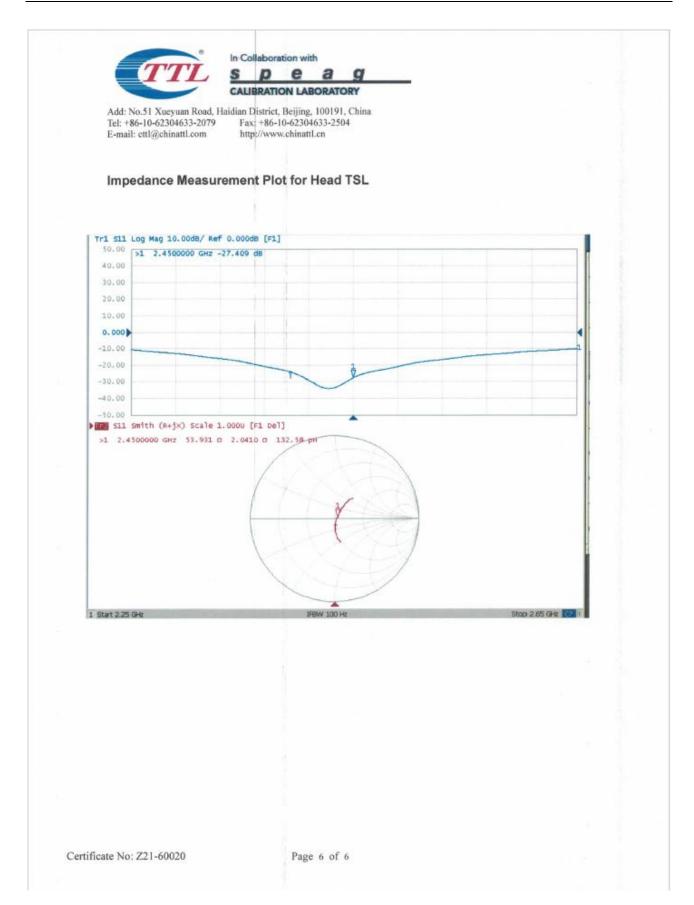
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.5 ± 6 %	1.81 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		1.000

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)

Antenna Parameters with Head TSL Impedance, transformed to feed point 53.9Ω+ 2.04jΩ Return Loss -27.4dB General Antenna Parameters and Design Electrical Delay (one direction) 1.064 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.
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Additional EUT Data
Manufactured by SPEAG





1.6. D2600V2 Dipole Calibration Certificate

Tel: +86-10-62304633-2 E-mail: cttl@chinattl.co	2079 Fax: +80-	t, Beijing, 100191, China 10-62304633-2504 w.chinattl.cn Certificate No: Z21	-60021
Client HTW			
ALIBRATION CEN			
Dbject	D2600V2	- SN: 1150	
Calibration Procedure(s)	FF-Z11-0 Calibratio	03-01 on Procedures for dipole validation kits	
Calibration date:	January	25, 2021	
	conducted in th	ne closed laboratory facility: environment	temperature(22±3)°C a
All calibrations have been on humidity<70%. Calibration Equipment used (r calibration)	
humidity<70%. Calibration Equipment used (Primary Standards	M&TE critical fo	r calibration) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibratio
humidity<70%.	M&TE critical fo	r calibration)	
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
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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	M&TE critical fo ID # 106276 101369 SN 7600 SN 771 ID # MY49071430 MY46110673	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 Calibratio May-21 May-21 Nov-21 Feb-21 Scheduled Calibrati 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 Calibrati 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%.

Certificate No: Z21-60021





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Measurement Conditions

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

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



Certificate	No:	Z2	1-60021

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