# **APPENDIX E - DIPOLE CALIBRATION CERTIFICATES**

Add: No.52 HuaYuanBei Roa	ad Haidian District		CALIBRATION CNAS L0570
Tel: +86-10-62304633-2117			
E-mail: emf@caict.ac.cn	http://www.caic		22-60477
Client BACI		Certificate No. 2	22-00-11
CALIBRATION CE	RTIFICAT	E	
Object	D750V	3 - SN: 1167	
Calibration Procedure(s)	FF-Z11	-003-01	
		tion Procedures for dipole validation kits	
Calibration date:	Octobe	r 31, 2022	
		the uncertainties with confidence probabilit	
All calibrations have been humidity<70%.	rtificate.	he closed laboratory facility: environment	t temperature (22±3)°C a
humidity<70%. Calibration Equipment used	rtificate.	he closed laboratory facility: environment	t temperature (22±3)°C an Scheduled Calibratio
All calibrations have been humidity<70%. Calibration Equipment used	rtificate. conducted in t (M&TE critical fo	he closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards	rtificate. conducted in t (M&TE critical fo ID #	he closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103)	
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2	rtificate. conducted in t (M&TE critical for ID # 106276	he closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.)	Scheduled Calibratic May-23 May-23
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A	rtificate. conducted in t (M&TE critical for ID # 106276 101369	he closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103)	Scheduled Calibratic May-23 May-23
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4	ID # 106276 101369 SN 7464	he closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22) 12-Jan-22(CTTL-SPEAG,No.Z22-60007)	Scheduled Calibratio May-23 May-23 Jan-23 Jan-23
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4	ortificate.         conducted in t         (M&TE critical for         ID #         106276         101369         SN 7464         SN 1556	he closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22)	Scheduled Calibratio May-23 May-23 Jan-23 Jan-23
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards	rtificate. conducted in t (M&TE critical for ID # 106276 101369 SN 7464 SN 1556 ID #	he closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22) 12-Jan-22(CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.)	Scheduled Calibratio May-23 May-23 Jan-23 Jan-23 Scheduled Calibratio
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	rtificate. conducted in t (M&TE critical for ID # 106276 101369 SN 7464 SN 1556 ID # ID # MY49071430	he closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22) 12-Jan-22(CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409)	Scheduled Calibratio May-23 May-23 Jan-23 Jan-23 Scheduled Calibratio Jan-23
All calibrations have been 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	rtificate. conducted in t (M&TE critical for 106276 101369 SN 7464 SN 1556 ID # MY49071430 MY46110673	he closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22) 12-Jan-22(CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409) 14-Jan-22 (CTTL, No.J22X00406)	Scheduled Calibratio May-23 May-23 Jan-23 Jan-23 Scheduled Calibration Jan-23 Jan-23
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	rtificate. conducted in t (M&TE critical for 10 # 106276 101369 SN 7464 SN 1556 ID # MY49071430 MY46110673 Name	he closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22 (CTTL, No.J22X03103) 26-Jan-22 (CTTL, No.J22X03103) 12-Jan-22 (CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409) 14-Jan-22 (CTTL, No.J22X00406) Function	Scheduled Calibratio May-23 May-23 Jan-23 Jan-23 Scheduled Calibration Jan-23 Jan-23

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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) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **Additional Documentation:**

c) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

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# Measurement Conditions

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

DASY Version	on DASY52	
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	42.0	0.90 mho/m
Measured Head TSL parameters	(22.0 ±0.2) ℃	42.3 ±6 %	0.88 mho/m ±6 %
Head TSL temperature change during test	<1.0 °C		

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.48 W/kg ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.63 W/kg ± 18.7 % (k=2)

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# Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.0Ω- 3.71jΩ	
Return Loss	- 26.7dB	

CAICT

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	0.957 ns

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

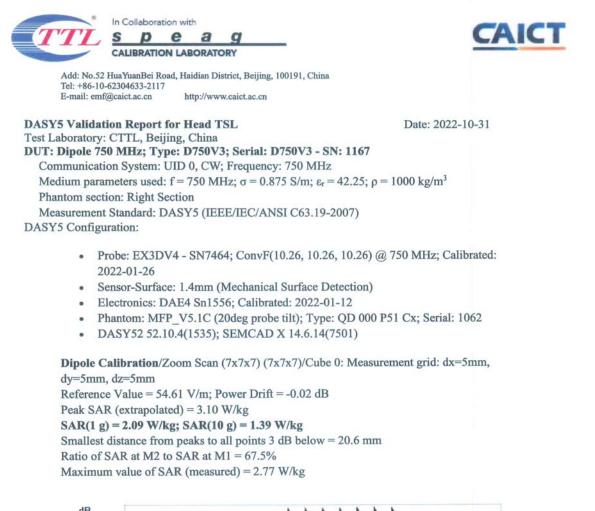
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching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

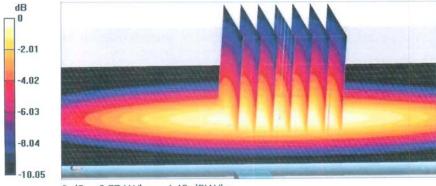
# Additional EUT Data

Manufactured by	SPEAG
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Certificate No: Z22-60477

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0 dB = 2.77 W/kg = 4.42 dBW/kg

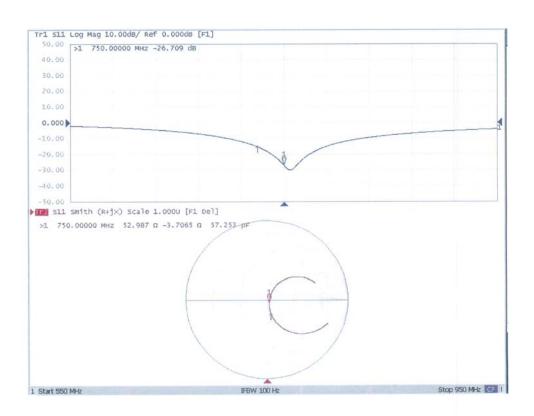
Certificate No: Z22-60477

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Impedance Measurement Plot for Head TSL



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# D750V3 - SN:1167 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.

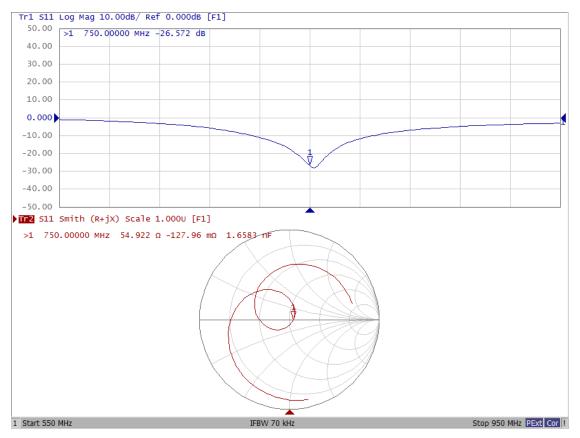
sustilication of th						
D750V3 - SN:1167						
			750MHz Head			
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2022/10/31 (Cal. Report)	-26.709	/	52.987	/	-3.7065	/
2023/10/30 (Extended)	-26.572	-0.51	54.922	1.935	-0.12796	3.57854

# Justification of the extended calibration

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

# Dipole Verification Data> D750V3 - SN:1167 (Date of Measurement: 2023/10/30)

# 750MHz - Head



	Name	Title	Signature
Measure By:	Mark Dong	SAR Engineer	Mark Jong

11	CALIBRA		中国认可国际互认
Add: No.52 HuaYu		District, Beijing, 100191, Chi	Aる 校准 CALIBRATIC
Tel: +86-10-623046 E-mail: cttl@chinat	533-2079 Fax: -	+86-10-62304633-2504 /www.chinattl.cn	CNAS L057
Client BACL		Certificate No: Z	21-60314
CALIBRATION CI	ERTIFICAT	TE	
Object	D835V	2 - SN: 453	
Calibration Procedure(s)	FE-711	-003-01	
		tion Procedures for dipole validation kits	
Calibration date:	August	31, 2021	
ages and are part of the ce All calibrations have been numidity<70%.	ertificate.	the closed laboratory facility: environment	
numidity<70%. Calibration Equipment used	conducted in t (M&TE critical for	the closed laboratory facility: environment or calibration)	temperature (22±3)°C an
ages and are part of the ce All calibrations have been numidity<70%. Calibration Equipment used	ertificate.	the closed laboratory facility: environment	temperature (22±3)°C an
Primary Standards	conducted in t (M&TE critical fr ID #	the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.)	temperature (22±3)°C an Scheduled Calibration
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2	M&TE critical from the conducted in the conducted in the critical from the critical	the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336)	temperature (22±3)°C an Scheduled Calibration Sep-21
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S	ID # 106277 104291	the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336)	temperature (22±3)℃ an Scheduled Calibration Sep-21 Sep-21
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4	ID # 106277 104291 SN 7517	the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 03-Feb-21(CTTL-SPEAG,No.Z21-60001)	temperature (22±3)℃ an Scheduled Calibration Sep-21 Sep-21 Feb-22
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE3	ID # 106277 104291 SN 7517 SN 536	the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 03-Feb-21(CTTL-SPEAG,No.Z21-60001) 06-Nov-20(CTTL-SPEAG,No.Z20-60452)	temperature (22±3)℃ an Scheduled Calibration Sep-21 Sep-21 Feb-22 Nov-21
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE3 Secondary Standards	ID # 106277 104291 SN 7517 SN 536 ID #	the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 03-Feb-21(CTTL-SPEAG,No.Z21-60001) 06-Nov-20(CTTL-SPEAG,No.Z20-60452) Cal Date (Calibrated by, Certificate No.)	temperature (22±3)℃ an Scheduled Calibration Sep-21 Sep-21 Feb-22 Nov-21 Scheduled Calibration
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE3 Secondary Standards Signal Generator E4438C	ertificate. conducted in t (M&TE critical for ID # 106277 104291 SN 7517 SN 7517 SN 536 ID # MY49071430	the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 03-Feb-21(CTTL-SPEAG,No.Z21-60001) 06-Nov-20(CTTL-SPEAG,No.Z20-60452) Cal Date (Calibrated by, Certificate No.) 01-Feb-21 (CTTL, No.J21X00593)	temperature (22±3)°C an Scheduled Calibration Sep-21 Sep-21 Feb-22 Nov-21 Scheduled Calibration Jan-22
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE3 Secondary Standards Signal Generator E4438C	ertificate. conducted in t (M&TE critical for ID # 106277 104291 SN 7517 SN 536 ID # MY49071430 MY46110673	the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 03-Feb-21 (CTTL-SPEAG,No.Z21-60001) 06-Nov-20(CTTL-SPEAG,No.Z20-60452) Cal Date (Calibrated by, Certificate No.) 01-Feb-21 (CTTL, No.J21X00593) 14-Jan-21 (CTTL, No.J21X00232)	temperature (22±3)°C an Scheduled Calibration Sep-21 Sep-21 Feb-22 Nov-21 Scheduled Calibration Jan-22 Jan-22
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE3 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	ertificate. conducted in t (M&TE critical for ID # 106277 104291 SN 7517 SN 536 ID # MY49071430 MY46110673 Name	the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 03-Feb-21(CTTL-SPEAG,No.Z21-60001) 06-Nov-20(CTTL-SPEAG,No.Z20-60452) Cal Date (Calibrated by, Certificate No.) 01-Feb-21 (CTTL, No.J21X00593) 14-Jan-21 (CTTL, No.J21X00232) Function	temperature (22±3)°C an Scheduled Calibration Sep-21 Sep-21 Feb-22 Nov-21 Scheduled Calibration Jan-22 Jan-22

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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.

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	835 MHz ± 1 MHz	

# Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.7 ± 6 %	0.88 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

# SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.33 W/kg ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.49 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.03 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	56.2Ω- 6.72jΩ	
Return Loss	- 21.3dB	

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.300 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	
ificate No: Z21-60314	Page 4 of 6		



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

Date: 08.31.2021

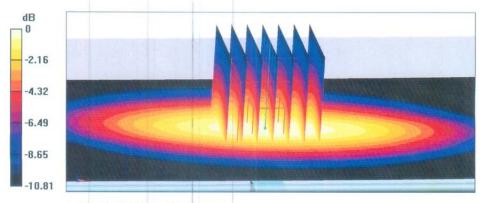
**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 453** Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: f = 835 MHz;  $\sigma = 0.884$  S/m;  $\varepsilon_r = 41.66$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 SN7517; ConvF(9.81, 9.81, 9.81) @ 835 MHz; Calibrated: 2021-02-03
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 2020-11-06
- 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 = 57.46 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 3.46 V/m; Power Drift = 0.07 dB Peak SAR (extrapolated) = 3.64 W/kg SAR(1 g) = 2.3 W/kg; SAR(10 g) = 1.49 W/kg Smallest distance from peaks to all points 3 dB below = 17.5 mm Ratio of SAR at M2 to SAR at M1 = 63.4%Maximum value of SAR (measured) = 3.16 W/kg



0 dB = 3.16 W/kg = 5.00 dBW/kg

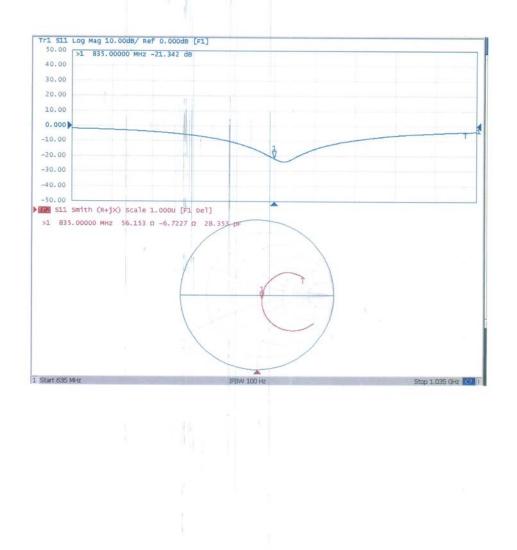
Certificate No: Z21-60314

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Add: No.52 HuaYuanBei Road, Haidian District, beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

# Impedance Measurement Plot for Head TSL



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# D835V2 - SN:453 Extended Dipole Calibrations

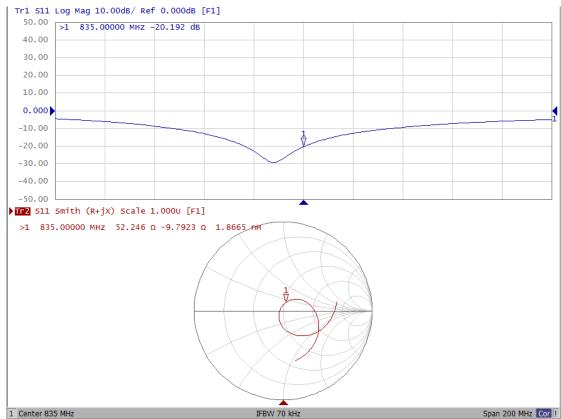
Referring to KDB865664 D01, if dipoles are verified in return loss(< -20dB, within 20% of prior calibration), and in impedance(within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

D835V2 - SN:453								
835MHz Head								
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)		
2021/8/31 (Cal. Report)	-21.342	/	56.153	/	-6.7227	/		
2022/8/30 (Extended)	-20.192	-5.39	52.246	-3.91	-9.7923	-3.07		
2023/8/30 (Extended)	-20.110	-5.77	53.060	-3.09	-9.1625	-2.44		

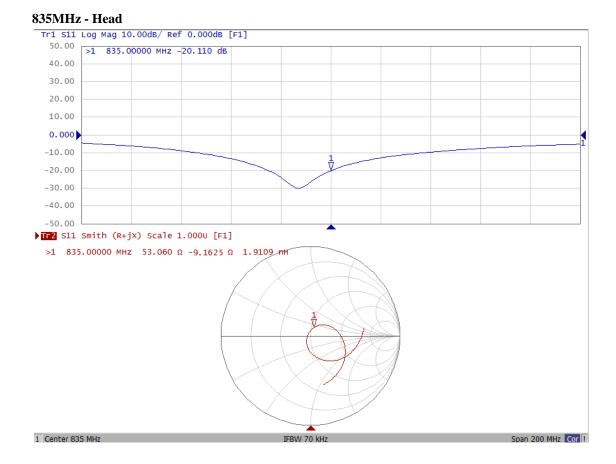
# Justification of the extended calibration

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

# Dipole Verification Data> D835V2 - SN:453 (Date of Measurement: 2022/8/30)



# 835MHz - Head



# Dipole Verification Data> D835V2 - SN:453 (Date of Measurement: 2023/8/30)

	Name	Title	Signature
Measure By:	Mark Dong	SAR Engineer	Mark Song

	T s p	TION LABORATORY	中国认可国际互认
Add: No.52 Hua Yu Tel: +86-10-623046 E-mail: cttl@chinat	633-2079 Fax: -	n District, Beijing, 100191, Ch +86-10-62304633-2504 /www.chinattl.cn	CALIBRATION CNAS L0570
Client BACL	ERTIFICAT	Certificate No:	Z21-60258
Dbject	D1750	V2 - SN: 1141	
Calibration Procedure(s)		-003-01 tion Procedures for dipole validation k	kits
Calibration date:	June 2	9, 2021	
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All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S	ID # 106277 104291	the closed laboratory facility: environ or calibration) Cal Date (Calibrated by, Certificate 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336)	nment temperature (22±3)°C and No.) Scheduled Calibration Sep-21 Sep-21 Sep-21 0084) Apr-22
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE4	ID # 106277 104291 SN 3846	the closed laboratory facility: environ or calibration) Cal Date (Calibrated by, Certificate 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 26-Apr-21(CTTL-SPEAG No.Z21-60	e No.) Scheduled Calibration Sep-21 Sep-21 2084) Apr-22 2002) Jan-22
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ID # 1062777 104291 SN 3846 SN 549	the closed laboratory facility: environ or calibration) Cal Date (Calibrated by, Certificate 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 26-Apr-21(CTTL-SPEAG, No.Z21-60 08-Jan-21(CTTL-SPEAG, No.Z21-60 Cal Date (Calibrated by, Certificate I	e No.) Scheduled Calibration Sep-21 Sep-21 2084) Apr-22 2002) Jan-22
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All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power Sensor NRP8S Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	ertificate. conducted in t (M&TE critical fill) ID # 106277 104291 SN 3846 SN 549 ID # MY49071430 MY46110673	the closed laboratory facility: environ or calibration) Cal Date (Calibrated by, Certificate 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 26-Apr-21(CTTL-SPEAG, No.Z21-60 08-Jan-21(CTTL-SPEAG, No.Z21-60 Cal Date (Calibrated by, Certificate 1 01-Feb-21 (CTTL, No.J21X00593)	e No.) Scheduled Calibration Sep-21 Sep-21 Sep-21 0084) Apr-22 0002) Jan-22 No.) Scheduled Calibration Jan-22
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power Sensor NRP8S Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	ertificate. conducted in t (M&TE critical fe ID # 106277 104291 SN 3846 SN 549 ID # ID # ID # ID # ID # ID # N 3846 SN 549 ID # ID #	the closed laboratory facility: environ or calibration) Cal Date (Calibrated by, Certificate 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 26-Apr-21(CTTL-SPEAG,No.Z21-60 08-Jan-21(CTTL-SPEAG,No.Z21-60 Cal Date (Calibrated by, Certificate 1 01-Feb-21 (CTTL, No.J21X00593) 14-Jan-21 (CTTL, No.J21X00232) Function	nment temperature (22±3)°C and No.) Scheduled Calibration Sep-21 Sep-21 0084) Apr-22 0002) Jan-22 No.) Scheduled Calibration Jan-22 Jan-22
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	ertificate. conducted in t (M&TE critical for ID # 106277 104291 SN 3846 SN 549 ID # MY49071430 MY46110673 Name Zhao Jing	the closed laboratory facility: environ or calibration) Cal Date (Calibrated by, Certificate 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 26-Apr-21(CTTL-SPEAG,No.Z21-60 08-Jan-21(CTTL-SPEAG,No.Z21-60 Cal Date (Calibrated by, Certificate 1 01-Feb-21 (CTTL, No.J21X00593) 14-Jan-21 (CTTL, No.J21X00232) Function	nment temperature (22±3)°C and No.) Scheduled Calibration Sep-21 Sep-21 0084) Apr-22 0002) Jan-22 No.) Scheduled Calibration Jan-22 Jan-22

Certificate No: Z21-60258

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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 DACY

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	1750 MHz ± 1 MHz	

Head TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.9 ± 6 %	1.36 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		1 <b></b>

## SAR result with Head TSL

SAR averaged over 1 $cm^3$ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.1 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	4.66 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	18.7 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	51.6Ω- 2.23jΩ	
Return Loss	- 31.3 dB	

# General Antenna Parameters and Design

Electrical Delay (one direction)	1.120 ns	
----------------------------------	----------	--

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

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

## Additional EUT Data

Manufactured by	SPEAG

Certificate No: Z21-60258

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

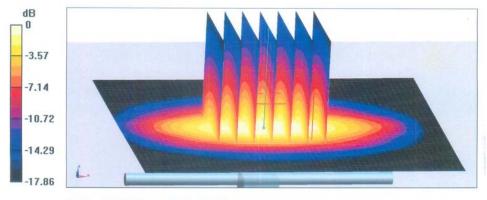
Date: 06.29.2021

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1141** Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1750 MHz;  $\sigma = 1.362$  S/m;  $\epsilon_r = 39.93$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(8.22, 8.22, 8.22) @ 1750 MHz; Calibrated: 2021-04-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn549; Calibrated: 2021-01-08
- 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)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 98.30 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 17.7 W/kg SAR(1 g) = 9.01 W/kg; SAR(10 g) = 4.66 W/kg Smallest distance from peaks to all points 3 dB below = 10.8 mm Ratio of SAR at M2 to SAR at M1 = 51% Maximum value of SAR (measured) = 14.4 W/kg



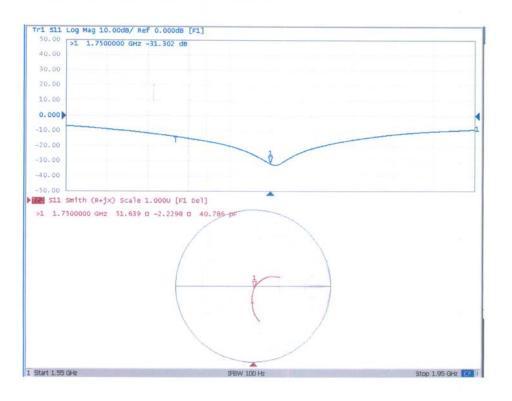
0 dB = 14.4 W/kg = 11.58 dBW/kg

Certificate No: Z21-60258

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# Impedance Measurement Plot for Head TSL



Certificate No: Z21-60258

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# D1750V2 - SN:1141 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.

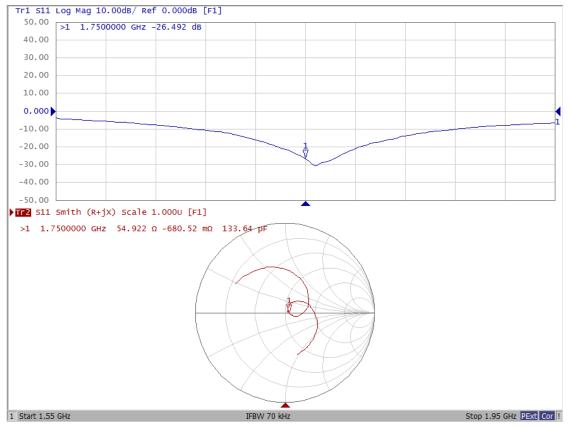
D1750V2 - SN:1141						
			1750MHz Head			
Impedance					Delta (ohm)	
2021/6/29 (Cal. Report)	-31.302	/	51.639	/	-2.2298	/
2022/6/28 (Extended)	-26.492	-15.37	54.922	3.283	-0.68052	1.54928
2023/6/28 (Extended)	-28.470	-9.05	53.955	2.316	-0.17559	2.05421

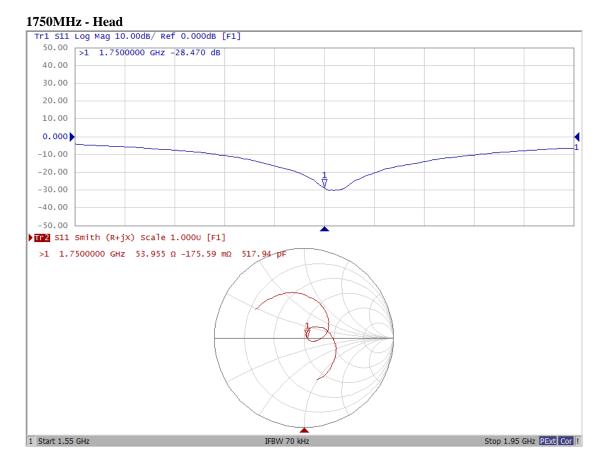
# Justification of the extended calibration

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

# Dipole Verification Data> D1750V2 - SN:1141 (Date of Measurement: 2022/6/28)

# 1750MHz - Head





# Dipole Verification Data> D1750V2 - SN:1141 (Date of Measurement: 2023/6/28)

	Name	Title	Signature
Measure By:	Mark Dong	SAR Engineer	Mark Jone

	tion with <b>e a g</b> ON LABORATORY		中国认可 国际互认 校准
Add: No.52 HuaYuanBei Ro Tel: +86-10-62304633-2117 E-mail: emf@caict.ac.cn			CALIBRATION CNAS L0570
Client BAC	L	Certificate No:	Z22-60478
CALIBRATION CI	ERTIFICAT	E	
Object	D1900\	/2 - SN: 543	
Calibration Procedure(s)	FF-Z11 Calibra	-003-01 tion Procedures for dipole validation kits	
Calibration date:	Novem	ber 2, 2022	
measurements (SI). The me pages and are part of the ce	asurements and ertificate. conducted in t	traceability to national standards, which the uncertainties with confidence probabi he closed laboratory facility: environme or calibration)	ility are given on the following
	ID #	Cal Date (Calibrated by, Certificate No.	) Scheduled Calibration
Primary Standards Power Meter NRP2	106276	10-May-22 (CTTL, No.J22X03103)	May-23
Power sensor NRP6A	101369	10-May-22 (CTTL, No.J22X03103)	May-23
Reference Probe EX3DV4	SN 7464	26-Jan-22(SPEAG,No.EX3-7464 Jan22	
DAE4	SN 1556	12-Jan-22(CTTL-SPEAG,No.Z22-60007	
Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-22 (CTTL, No.J22X00409)	Jan-23
Network Analyzer E5071C	MY46110673	14-Jan-22 (CTTL, No.J22X00406)	Jan-23
	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	A STATE
Reviewed by:	Lin Hao	SAR Test Engineer	二林光
Approved by:	Qi Dianyuan	SAR Project Leader	Na
			ovember 7, 2022
This calibration certificate sl	hall not be reproc	duced except in full without written approv	al of the laboratory.
Certificate No: Z22-6047	8	Page 1 of 6	
Certificate No: Z22-6047	8	Page 1 of 6	





#### **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) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

c) 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: Z22-60478

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#### **Measurement Conditions**

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

DASY Version	DASY52	52.10.4
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) ℃	40.5 ±6 %	1.39 mho/m ±6 %
Head TSL temperature change during test	<1.0 °C	-	-

# SAR result with Head TSL

SAR averaged over 1 $cm^3$ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.96 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.2 W/kg ±18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.9 W/kg ±18.7 % (k=2)

Certificate No: Z22-60478

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#### Appendix (Additional assessments outside the scope of CNAS L0570)

# Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.9Ω+ 3.89jΩ	
Return Loss	- 28.2dB	

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.107 ns	
----------------------------------	----------	--

After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point 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 feed-point may be damaged.

#### **Additional EUT Data**

Manufactured by	SPEAG	

Certificate No: Z22-60478

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#### **DASY5 Validation Report for Head TSL** Test Laboratory: CTTL, Beijing, China

Date: 2022-11-02

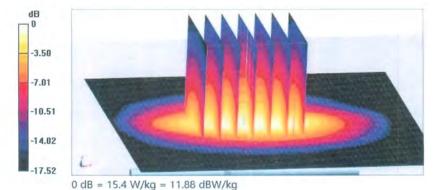
**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 543** Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz;  $\sigma = 1.388$  S/m;  $\varepsilon_r = 40.5$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(8.18, 8.18, 8.18) @ 1900 MHz; Calibrated: 2022-01-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2022-01-12
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**Dipole Calibration**/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 100.4 V/m; Power Drift = 0.05 dB Peak SAR (extrapolated) = 18.5 W/kg

SAR(1 g) = 9.96 W/kg; SAR(10 g) = 5.2 W/kg Smallest distance from peaks to all points 3 dB below = 9.8 mm Ratio of SAR at M2 to SAR at M1 = 54.6% Maximum value of SAR (measured) = 15.4 W/kg

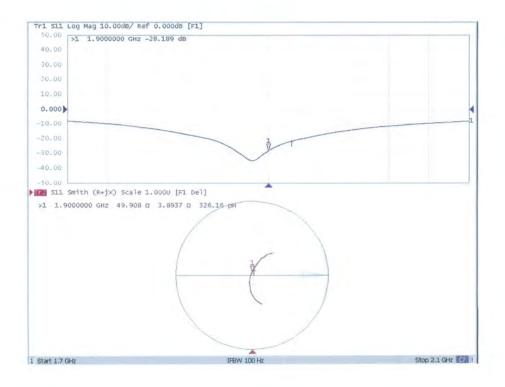


Certificate No: Z22-60478

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Impedance Measurement Plot for Head TSL



CAICT

Certificate No: Z22-60478

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# D1900V2 - SN:543 Extended Dipole Calibrations

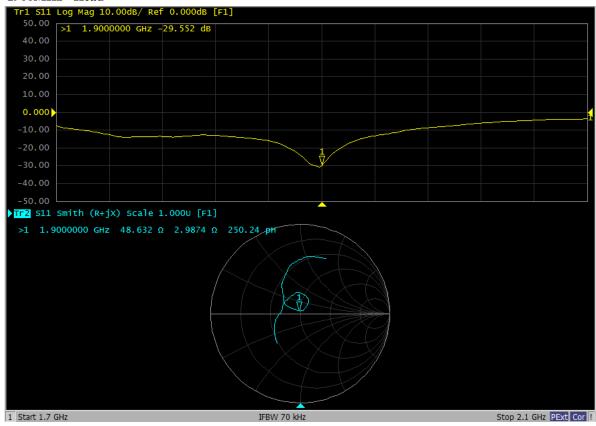
Referring to KDB865664 D01, if dipoles are verified in return loss(< -20dB, within 20% of prior calibration), and in impedance(within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

D1900V2 - SN:543						
1900MHz Head						
Date of MeasurementReturn-Loss (dB)Delta (%)Real Impedance (ohm)Delta (ohm)Imaginary Impedance (ohm)Delta (ohm)						
2022/11/2 (Cal. Report)	-28.189	/	49.908	/	3.8937	/
2023/11/1 (Extended)	-29.552	4.84	48.632	-1.276	2.9874	-0.9063

# Justification of the extended calibration

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

# Dipole Verification Data> D1900V2 - SN:543 (Date of Measurement: 2023/11/1)



# 1900MHz - Head

	Name	Title	Signature
Measure By:	Mark Dong	SAR Engineer	Mark Song

T	TL S P	oration with e a g ITION LABORATORY	中国认可国际互认发
Add: No.52 HuaYu Tel: +86-10-62304 E-mail: cttl@china	633-2079 Fax: -	District, Beijing, 100191, Chi +86-10-62304633-2504 /www.chinattl.cn	校准 CALIBRATION CNAS L0570
Client BAC	L	Certificate No: Z	221-60260
CALIBRATION C	ERTIFICAT	TE	
Object	D2450	V2 - SN: 971	
Calibration Procedure(s)	FF-Z11	-003-01	
	Calibra	tion Procedures for dipole validation kits	
Calibration date:	June 2	8, 2021	
This calibration Certificate measurements (SI). The me		traceability to national standards, which re	
measurements (SI). The me pages and are part of the ce All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S	easurements and ertificate. conducted in t (M&TE critical for ID # 106277 104291	I the uncertainties with confidence probabilit	y are given on the following
measurements (SI). The me pages and are part of the ce All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2	easurements and ertificate. conducted in t (M&TE critical find ID # 1062777 104291	the uncertainties with confidence probabilit the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No. 20X08336)	y are given on the following t temperature (22±3)°C and Scheduled Calibration Sep-21
measurements (SI). The me pages and are part of the ce All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4	conducted in t conducted in t (M&TE critical find) ID# 1062777 104291 SN 3846	the uncertainties with confidence probabilit the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 26-Apr-21(CTTL-SPEAG,No.Z21-60084)	y are given on the following t temperature (22±3)°C and Scheduled Calibration Sep-21 Sep-21 Apr-22
measurements (SI). The me pages and are part of the ce All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE4	easurements and ertificate. conducted in t (M&TE critical fit 106277 104291 SN 3846 SN 549 ID # ID # ID #	the uncertainties with confidence probabilit the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 26-Apr-21(CTTL-SPEAG,No.Z21-60084) 08-Jan-21(CTTL-SPEAG,No.Z21-60002)	y are given on the following temperature (22±3)°C and Scheduled Calibration Sep-21 Sep-21 Apr-22 Jan-22
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measurements (SI). The me pages and are part of the ce All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	easurements and ertificate. conducted in t (M&TE critical fit 106277 104291 SN 3846 SN 549 ID # MY49071430 MY46110673	the uncertainties with confidence probabilit the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336) 26-Apr-21(CTTL-SPEAG,No.Z21-60084) 08-Jan-21(CTTL-SPEAG,No.Z21-60002) Cal Date (Calibrated by, Certificate No.) 01-Feb-21 (CTTL, No.J21X00593) 14-Jan-21 (CTTL, No.J21X00232)	y are given on the following temperature (22±3)°C and Scheduled Calibration Sep-21 Sep-21 Apr-22 Jan-22 Scheduled Calibration Jan-22 Jan-22
measurements (SI). The me pages and are part of the ca All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power Sensor NRP8S Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	conducted in t conducted in t (M&TE critical fi 106277 104291 SN 3846 SN 549 ID # MY49071430 MY46110673 Name	the uncertainties with confidence probabilit the closed laboratory facility: environment or calibration) Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336) 26-Apr-21(CTTL-SPEAG,No.Z21-60084) 08-Jan-21(CTTL-SPEAG,No.Z21-60002) Cal Date (Calibrated by, Certificate No.) 01-Feb-21 (CTTL, No.J21X00593) 14-Jan-21 (CTTL, No.J21X00232) Function	y are given on the following temperature (22±3)°C and Scheduled Calibration Sep-21 Sep-21 Apr-22 Jan-22 Scheduled Calibration Jan-22 Jan-22

Certificate No: Z21-60260

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### Glossary:

ISL	
ConvF	
N/A	

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

# Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "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: Z21-60260

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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	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

# Head TSL parameters

	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	39.1 ± 6 %	1.78 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	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.5 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.2 W/kg ± 18.7 % (k=2)

Certificate No: Z21-60260

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# Appendix (Additional assessments outside the scope of CNAS L0570)

http://www.chinattl.cn

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.7Ω+ 4.06jΩ	
Return Loss	- 23.6dB	

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.071 ns
----------------------------------	----------

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

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

#### Additional EUT Data

Manufactured by	SPEAG
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Certificate No: Z21-60260

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

E-mail: cttl@chinattl.com

Date: 06.28.2021

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 971** Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2450 MHz;  $\sigma = 1.779$  S/m;  $\epsilon_r = 39.12$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Center Section

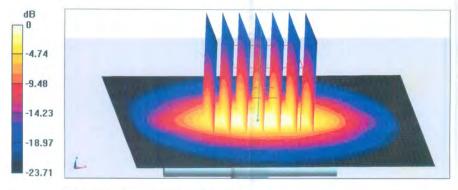
http://www.chinattl.cn

DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(7.45, 7.45, 7.45) @ 2450 MHz; Calibrated: 2021-04-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn549; Calibrated: 2021-01-08
- 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 = 106.9 V/m; Power Drift = 0.02 dBPeak SAR (extrapolated) = 28.8 W/kg SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.04 W/kg Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 45.6% Maximum value of SAR (measured) = 22.8 W/kg



0 dB = 22.8 W/kg = 13.58 dBW/kg

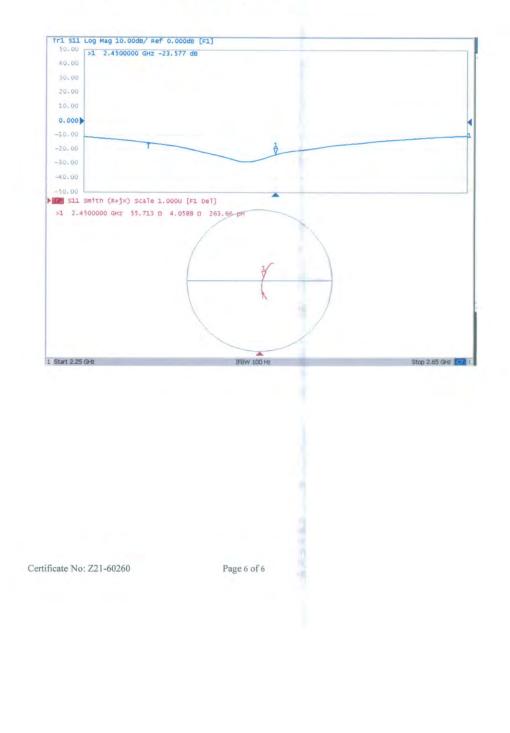
Certificate No: Z21-60260

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#### Impedance Measurement Plot for Head TSL



## D2450V2 - SN:971 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.

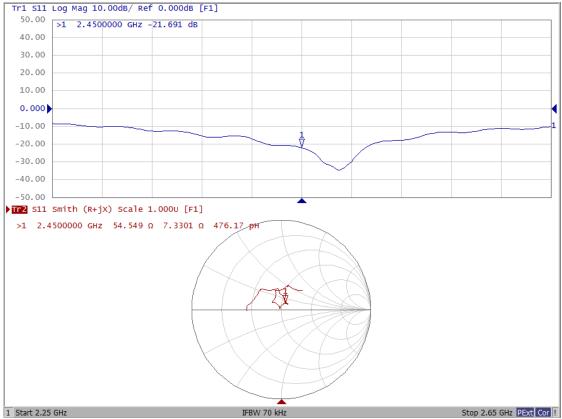
Justification of the extended campration								
D2450V2 - SN:971								
	2450MHz Head							
Date of MeasurementReturn-Loss (dB)Delta (%)Real Impedance (ohm)Delta (ohm)Imaginary Impedance (ohm)Delta (ohm)								
2021/6/28 (Cal. Report)	-23.577	/	55.713	/	4.0588	/		
2022/6/27 (Extended)	-21.691	-8	54.549	-1.164	7.3301	3.2713		
2023/6/27 (Extended)	-21.918	-7.04	54.157	-1.556	7.2675	3.2087		

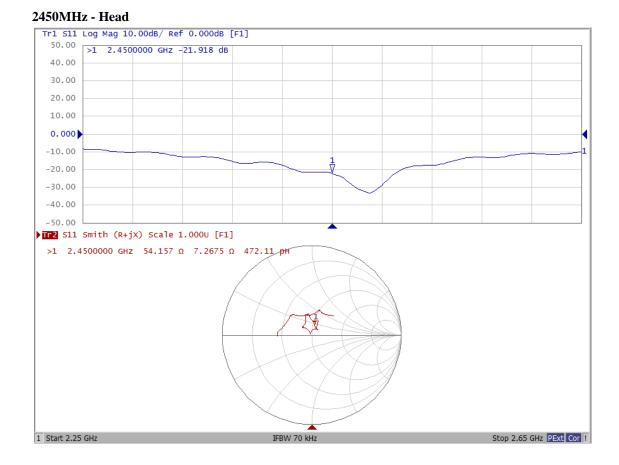
## Justification of the extended calibration

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

# Dipole Verification Data> D2450V2 - SN:971 (Date of Measurement: 2022/6/27)







# Dipole Verification Data> D2450V2 - SN:971 (Date of Measurement: 2023/6/27)

	Name	Title	Signature
Measure By:	Mark Dong	SAR Engineer	Mark Jong

Add: No.52 Hua YuanBei Ros Tel: +86-10-62304633-2117	ad, Haidian District,	Beijing, 100191	AS L0570
E-mail: emf@caict.ac.cn	http://www.caict		0.00470
Client BACI			2-60479
CALIBRATION CE	ERTIFICAT	E	
Dbject	D2600\	/2 - SN: 1132	
alibration Procedure(s)	FF-Z11	-003-01	
		tion Procedures for dipole validation kits	
Calibration date:	Novem	ber 1, 2022	
ages and are part of the ce			
I calibrations have been umidity<70%.	conducted in t	he closed laboratory facility: environment t or calibration)	emperature (22±3)°C and
All calibrations have been numidity<70%. Calibration Equipment used	conducted in t	or calibration)	emperature (22±3)°C and
I calibrations have been umidity<70%.	ertificate. conducted in the conducted in the conducted in the conducted in the conducted for the cond		
All calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2	conducted in the conduc	or calibration) Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
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all calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4	rtificate. conducted in the conducted for the conduc	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103)	Scheduled Calibration May-23 May-23
Il calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4	ID # 106276 101369 SN 7464	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22)	Scheduled Calibration May-23 May-23 Jan-23
Il calibrations have been umidity<70%. Calibration Equipment used Primary Standards	rtificate. conducted in the (M&TE critical for ID # 106276 101369 SN 7464 SN 1556	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22) 12-Jan-22(CTTL-SPEAG,No.Z22-60007)	Scheduled Calibration May-23 May-23 Jan-23 Jan-23
Il calibrations have been umidity<70%. Calibration Equipment used rimary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	artificate.         conducted in the conducted in t	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22) 12-Jan-22(CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration May-23 May-23 Jan-23 Jan-23 Scheduled Calibration
All calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards	rtificate. conducted in t (M&TE critical for ID # 106276 101369 SN 7464 SN 1556 ID # ID # MY49071430	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22) 12-Jan-22(CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409)	Scheduled Calibration May-23 May-23 Jan-23 Jan-23 Scheduled Calibration Jan-23
All calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C Network Analyzer E5071C	rtificate. conducted in t (M&TE critical for 108276 101369 SN 7464 SN 1556 ID # MY49071430 MY46110673	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22 (CTTL, No.J22X03103) 26-Jan-22 (CTTL-SPEAG,No.EX3-7464_Jan22) 12-Jan-22 (CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409) 14-Jan-22 (CTTL, No.J22X00406)	Scheduled Calibration May-23 May-23 Jan-23 Jan-23 Scheduled Calibration Jan-23 Jan-23
All calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	rtificate. conducted in the (M&TE critical for 10 # 106276 101369 SN 7464 SN 1556 ID # MY49071430 MY46110673 Name	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22) 12-Jan-22(CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409) 14-Jan-22 (CTTL, No.J22X00406) Function	Scheduled Calibration May-23 May-23 Jan-23 Jan-23 Scheduled Calibration Jan-23 Jan-23

Certificate No: Z22-60479

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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) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

c) 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: Z22-60479

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## **Measurement Conditions**

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

DASY Version	DASY52	52.10.4
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	2600 MHz ±1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ±0.2) ℃	39.0 ±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 <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	55.8 W/kg ±18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.4 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	47.0Ω- 6.44jΩ
Return Loss	- 22.7dB

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.058 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point 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 feed-point may be damaged.

### **Additional EUT Data**

Manufactured by	SPEAG
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#### DASY5 Validation Report for Head TSL Test Laboratory: CTTL, Beijing, China

Date: 2022-11-01

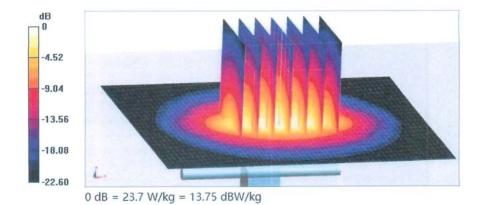
**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1132** Communication System: UID 0, CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz;  $\sigma = 1.974$  S/m;  $\varepsilon_r = 39.04$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(7.64, 7.64, 7.64) @ 2600 MHz; Calibrated: 2022-01-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2022-01-12
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Reference Value = 103.1 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 29.2 W/kg SAR(1 g) = 14 W/kg; SAR(10 g) = 6.35 W/kg Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 48.5% Maximum value of SAR (measured) = 23.7 W/kg

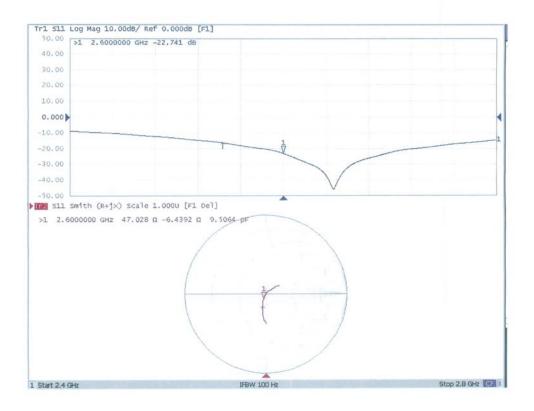


Certificate No: Z22-60479

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Impedance Measurement Plot for Head TSL



CAICT

Certificate No: Z22-60479

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## D2600V2 - SN:1132 Extended Dipole Calibrations

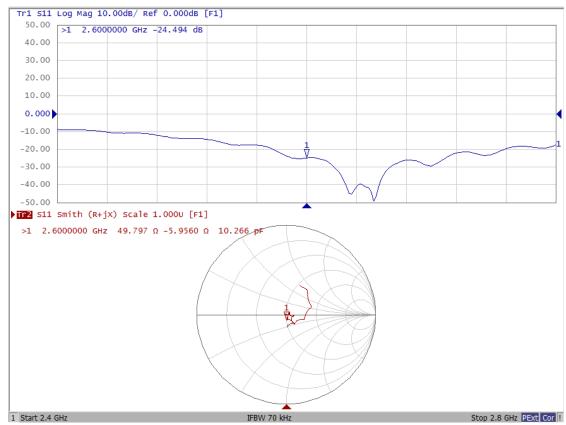
Referring to KDB 865664 D01, if dipoles are verified in return loss(< -20dB, within 20% of prior calibration), and in impedance(within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

D2600V2 - SN:1132							
2600MHz Head							
Date of MeasurementReturn-Loss (dB)Delta (%)Real Impedance (ohm)Delta (ohm)Imaginary Impedance (ohm)Delta (ohm)							
2022/11/1 (Cal. Report)	-22.741	/	47.028	/	-6.4392	/	
2023/10/31 (Extended)	-24.494	7.71	49.797	2.769	-5.9560	0.4832	

### Justification of the extended calibration

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

## Dipole Verification Data> D2600V2 - SN:1132 (Date of Measurement: 2023/10/31)



## 2600MHz - Head

	Name	Title	Signature
Measure By:	Mark Dong	SAR Engineer	Mark Song

Add: No.52 HuaYuanBei Ro Tel: +86-10-62304633-2117 E-mail: emf@caict.ac.cn	http://www.caic.	ac.cn	2-60480
0			2-60480
Client BAC			
Cheffe			
CALIBRATION CE	ERTIFICAT	E	
Object	D5GHz	V2 - SN: 1246	
Calibration Procedure(s)	FF-Z11	-003-01	
		tion Procedures for dipole validation kits	
Calibration date:	Novem	ber 1, 2022	
This collibration Cortificate	documento the l	researchility to notional standards, which rea	lize the physical units of
		traceability to national standards, which rea	
		the uncertainties with confidence probability	are given on the following
pages and are part of the ce	ertificate.		
All calibrations have been	conducted in t	be closed laboratory facility: environment	temperature (22+3)°C and
	conducted in the	he closed laboratory facility: environment	temperature (22±3)°C and
	conducted in the	he closed laboratory facility: environment	temperature (22±3)°C and
	conducted in t	he closed laboratory facility: environment	temperature (22±3)°C and
humidity<70%.			temperature (22±3)°C and
humidity<70%.			temperature (22±3)°C and
humidity<70%. Calibration Equipment used			temperature (22±3)°C and Scheduled Calibration
humidity<70%. Calibration Equipment used	(M&TE critical fo	or calibration)	
humidity<70%. Calibration Equipment used Primary Standards	(M&TE critical fo	or calibration) Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2	(M&TE critical fo ID # 106276	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103)	Scheduled Calibration May-23
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A	(M&TE critical fo ID # 106276 101369	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103)	Scheduled Calibration May-23 May-23
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4	(M&TE critical fo ID # 106276 101369 SN 7464	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22)	Scheduled Calibration May-23 May-23 Jan-23
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 7464 SN 1556	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22) 12-Jan-22(CTTL-SPEAG,No.Z22-60007)	Scheduled Calibration May-23 May-23 Jan-23 Jan-23
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards	(M&TE critical fo ID # 106276 101369 SN 7464 SN 1556 ID #	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22) 12-Jan-22(CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration May-23 May-23 Jan-23 Jan-23 Scheduled Calibration
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 7464 SN 1556 ID # MY49071430 MY46110673	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22 (CTTL, No.J22X03103) 12-Jan-22 (CTTL-SPEAG,No.EX3-7464_Jan22) 12-Jan-22 (CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409) 14-Jan-22 (CTTL, No.J22X00406)	Scheduled Calibration May-23 May-23 Jan-23 Jan-23 Scheduled Calibration Jan-23 Jan-23
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 7464 SN 1556 ID # MY49071430	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22) 12-Jan-22(CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No. J22X00409)	Scheduled Calibration May-23 May-23 Jan-23 Jan-23 Scheduled Calibration Jan-23
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 7464 SN 1556 ID # MY49071430 MY46110673	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22 (CTTL, No.J22X03103) 12-Jan-22 (CTTL-SPEAG,No.EX3-7464_Jan22) 12-Jan-22 (CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409) 14-Jan-22 (CTTL, No.J22X00406)	Scheduled Calibration May-23 May-23 Jan-23 Jan-23 Scheduled Calibration Jan-23 Jan-23
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 7464 SN 1556 ID # MY49071430 MY46110673 Name	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(SPEAG,No.EX3-7464_Jan22) 12-Jan-22(CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409) 14-Jan-22 (CTTL, No.J22X00406) Function	Scheduled Calibration May-23 May-23 Jan-23 Jan-23 Scheduled Calibration Jan-23 Jan-23
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 for ID # 106276 101369 SN 7464 SN 1556 ID # MY49071430 MY46110673 Name Zhao Jing	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103) 10-May-22 (CTTL, No.J22X03103) 26-Jan-22(CTTL, No.J22X03103) 26-Jan-22(CTTL-SPEAG,No.Z22-60007) 12-Jan-22(CTTL-SPEAG,No.Z22-60007) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409) 14-Jan-22 (CTTL, No.J22X00406)  Function SAR Test Engineer	Scheduled Calibration May-23 May-23 Jan-23 Jan-23 Scheduled Calibration Jan-23 Jan-23

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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) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **Additional Documentation:**

c) 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. 52.10.4 **DASY Version** DASY52 Extrapolation Advanced Extrapolation Triple Flat Phantom 5.1C Phantom **Distance Dipole Center - TSL** 10 mm with Spacer Graded Ratio = 1.4 (Z direction) **Zoom Scan Resolution** dx, dy = 4 mm, dz = 1.4 mm 5250 MHz ±1 MHz 5600 MHz ±1 MHz 5750 MHz ±1 MHz Frequency

#### Head TSL parameters at 5250MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ±0.2) ℃	35.2 ±6 %	4.68 mho/m ±6 %
Head TSL temperature change during test	<1.0 °C		

#### SAR result with Head TSL at 5250MHz

SAR averaged over 1 $cm^3$ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.5 W/kg ±24.4 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.0 W/kg ±24.2 % (k=2)

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## Head TSL parameters at 5600MHz

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ±0.2) °C	34.6 ±6 %	5.05 mho/m ±6 %
Head TSL temperature change during test	<1.0 ℃		

### SAR result with Head TSL at 5600MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.7 W/kg ±24.4 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.8 W/kg ±24.2 % (k=2)

## Head TSL parameters at 5750MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ±0.2) ℃	34.4 ±6 %	5.21 mho/m ±6 %
Head TSL temperature change during test	<1.0 °C		

#### SAR result with Head TSL at 5750MHz

SAR averaged over 1 $cm^3$ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.89 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.4 W/kg ±24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.0 W/kg ±24.2 % (k=2)

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#### Appendix (Additional assessments outside the scope of CNAS L0570)

#### Antenna Parameters with Head TSL at 5250MHz

Impedance, transformed to feed point	49.1Ω- 3.09jΩ
Return Loss	- 29.8dB

#### Antenna Parameters with Head TSL at 5600MHz

Impedance, transformed to feed point	52.0Ω+ 4.16jΩ
Return Loss	- 26.9dB

#### Antenna Parameters with Head TSL at 5750MHz

Impedance, transformed to feed point	53.5Ω+ 2.47jΩ	
Return Loss	- 27.6dB	

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.097 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point 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 feed-point may be damaged.

#### **Additional EUT Data**

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL

Date: 2022-11-01

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1246

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz Medium parameters used: f = 5250 MHz;  $\sigma$  = 4.677 S/m;  $\epsilon$ r = 35.15;  $\rho$  = 1000 kg/m<sup>3</sup>

Medium parameters used: f = 5600 MHz;  $\sigma$  = 5.047 S/m;  $\epsilon_r$  = 34.56;  $\rho$  = 1000 kg/m<sup>3</sup> Medium parameters used: f = 5750 MHz;  $\sigma$  = 5.211 S/m;  $\epsilon_r$  = 34.35;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Right Section

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

- Probe: EX3DV4 SN7464; ConvF(5.43, 5.43, 5.43) @ 5250 MHz; ConvF(4.91, 4.91, 4.91) @ 5600 MHz; ConvF(4.85, 4.85, 4.85) @ 5750 MHz; Calibrated: 2022-01-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2022-01-12
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 65.38 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 31.5 W/kg SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.21 W/kg Smallest distance from peaks to all points 3 dB below = 6.9 mm Ratio of SAR at M2 to SAR at M1 = 64.9% Maximum value of SAR (measured) = 17.9 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 65.26 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 35.8 W/kg SAR(1 g) = 8.11 W/kg; SAR(10 g) = 2.3 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 62.3% Maximum value of SAR (measured) = 19.2 W/kg

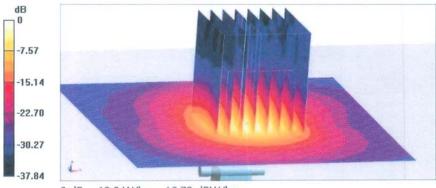
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Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 63.56 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 36.7 W/kg SAR(1 g) = 7.89 W/kg; SAR(10 g) = 2.22 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 60.9% Maximum value of SAR (measured) = 19.0 W/kg



0 dB = 19.0 W/kg = 12.79 dBW/kg

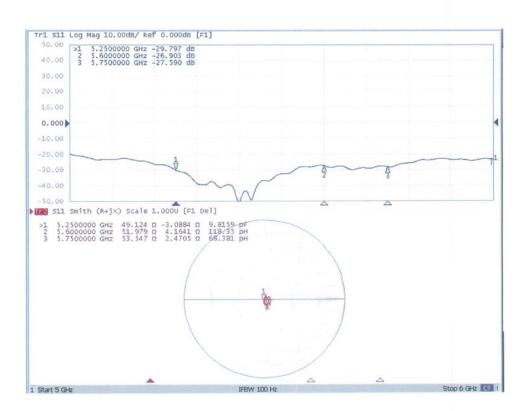
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Impedance Measurement Plot for Head TSL



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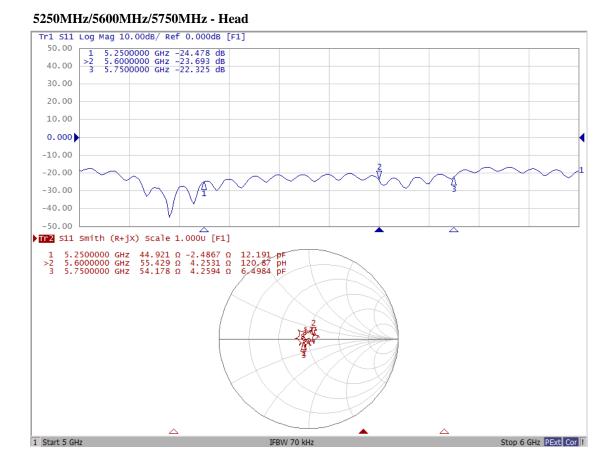
# D5GHzV2 - SN:1246 Extended Dipole Calibrations

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.

D5GHzV2 - SN:1246								
5250MHz Head								
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)		
2022/11/1 (Cal. Report)	-29.797	/	49.124	/	-3.0884	/		
2023/10/31 (Extended)	-24.478	-17.85	44.921	-4.203	-2.4867	0.6017		
5600MHz Head								
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)		
2022/11/1 (Cal. Report)	-26.903	/	51.979	/	4.1641	/		
2023/10/31 (Extended)	-23.693	-11.93	55.429	3.45	4.2531	0.089		
5750MHz Head								
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)		
2022/11/1 (Cal. Report)	-27.590	/	53.547	/	2.4705	/		
2023/10/31 (Extended)	-22.325	-19.08	54.178	0.631	4.2594	1.7889		

## Justification of the extended calibration

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.



# Dipole Verification Data> D5GHzV2 - SN:1246 (Date of Measurement: 2023/10/31)

	Name	Title	Signature
Measure By:	Mark Dong	SAR Engineer	Mark Jong