## APPENDIX E - DIPOLE CALIBRATION CERTIFICATES

	In Collab	oration with	中国认可
		ATION LABORATORY	国际互认
and the second se		ILLC=HILVE	
Add: No.52 HuaYu Tel: +86-10-623046 E-mail: cttl@chinat	533-2079 Fax: -	1 District, Beijing, 100191, Chi +86-10-62304633-2504 //www.chinattl.cn	CALIBRATION CNAS L0570
Client BACL		Certificate No: Z	21-60314
CALIBRATION CI	ERTIFICAT	ſE	
Dbject	D835V	/2 - SN: 453	15-an-5-ci
	00001	2 01. 100	
Calibration Procedure(s)	FF-711	1-003-01	
		ation Procedures for dipole validation kits	
Calibration date:	August	1 31, 2021	
Il calibrations have been		the closed laboratory facility: environment	temperature (22±3)°C and
Il calibrations have been umidity<70%. Calibration Equipment used	conducted in t		temperature (22±3)°C and
Il calibrations have been umidity<70%. alibration Equipment used	conducted in t		temperature (22±3)°C and Scheduled Calibration
II calibrations have been umidity<70%. alibration Equipment used rimary Standards Power Meter NRP2	conducted in t (M&TE critical f ID # 106277	Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336)	
Il calibrations have been umidity<70%. alibration Equipment used rimary Standards Power Meter NRP2 Power sensor NRP8S	conducted in 1 (M&TE critical fr ID # 106277 104291	Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336)	Scheduled Calibration Sep-21 Sep-21
Il calibrations have been umidity<70%. Calibration Equipment used trimary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4	conducted in 1 (M&TE critical fr ID # 106277 104291 SN 7517	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)	Scheduled Calibration Sep-21 Sep-21 Feb-22
Il calibrations have been umidity<70%. alibration Equipment used rimary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4	conducted in 1 (M&TE critical fr ID # 106277 104291	Cal Date (Calibrated by, Certificate No.) 23-Sep-20 (CTTL, No.J20X08336) 23-Sep-20 (CTTL, No.J20X08336)	Scheduled Calibration Sep-21 Sep-21
Il calibrations have been umidity<70%. Calibration Equipment used rimary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE3	conducted in 1 (M&TE critical fr ID # 106277 104291 SN 7517	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)	Scheduled Calibration Sep-21 Sep-21 Feb-22 Nov-21
All calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE3 Secondary Standards	conducted in 1 (M&TE critical fr ID # 106277 104291 SN 7517 SN 536	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)	Scheduled Calibration Sep-21 Sep-21 Feb-22
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE3 Secondary Standards Signal Generator E4438C	conducted in 1 (M&TE critical for 106277 104291 SN 7517 SN 536 ID #	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.)	Scheduled Calibration Sep-21 Sep-21 Feb-22 Nov-21 Scheduled Calibration
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE3 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	conducted in 1 (M&TE critical fr 106277 104291 SN 7517 SN 536 ID # MY49071430 MY46110673	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)	Scheduled Calibration Sep-21 Sep-21 Feb-22 Nov-21 Scheduled Calibration Jan-22 Jan-22
All calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE3 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	conducted in 1 (M&TE critical f 106277 104291 SN 7517 SN 536 ID # MY49071430	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)	Scheduled Calibration Sep-21 Sep-21 Feb-22 Nov-21 Scheduled Calibration Jan-22
Il calibrations have been umidity<70%. Calibration Equipment used trimary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE3 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	conducted in 1 (M&TE critical fr 106277 104291 SN 7517 SN 536 ID # MY49071430 MY46110673	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)	Scheduled Calibration Sep-21 Sep-21 Feb-22 Nov-21 Scheduled Calibration Jan-22 Jan-22
All calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE3 Secondary Standards Signal Generator E4438C	conducted in f (M&TE critical f 106277 104291 SN 7517 SN 536 ID # MY49071430 MY46110673 Name	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	Scheduled Calibration Sep-21 Sep-21 Feb-22 Nov-21 Scheduled Calibration Jan-22 Jan-22
All calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP8S Reference Probe EX3DV4 DAE3 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	conducted in f (M&TE critical f 106277 104291 SN 7517 SN 536 ID # MY49071430 MY46110673 Name Zhao Jing	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 SAR Test Engineer	Scheduled Calibration Sep-21 Sep-21 Feb-22 Nov-21 Scheduled Calibration Jan-22 Jan-22

Certificate No: Z21-60314

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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
----------------------------------	----------

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: Z21-60314	Page 4 of 6		



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

Date: 08.31.2021

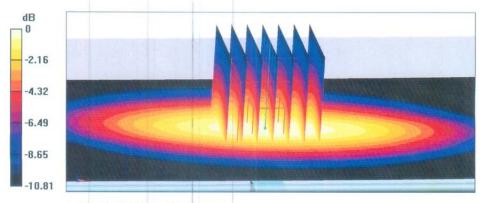
**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 453** Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: f = 835 MHz;  $\sigma = 0.884$  S/m;  $\varepsilon_r = 41.66$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Right Section

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

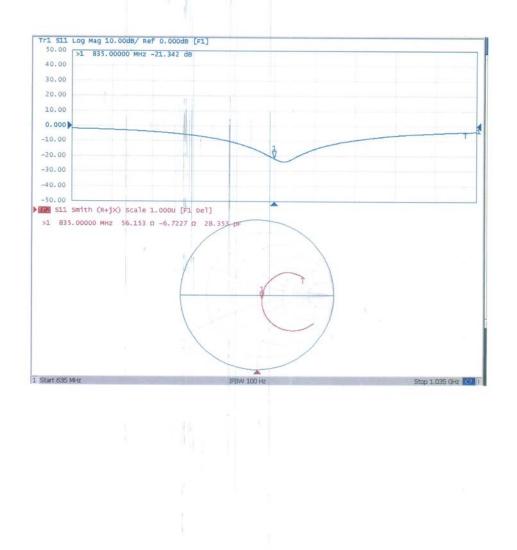
Certificate No: Z21-60314

Page 5 of 6



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## Impedance Measurement Plot for Head TSL



Certificate No: Z21-60314

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## D835V2 - SN:453 Extended Dipole Calibrations

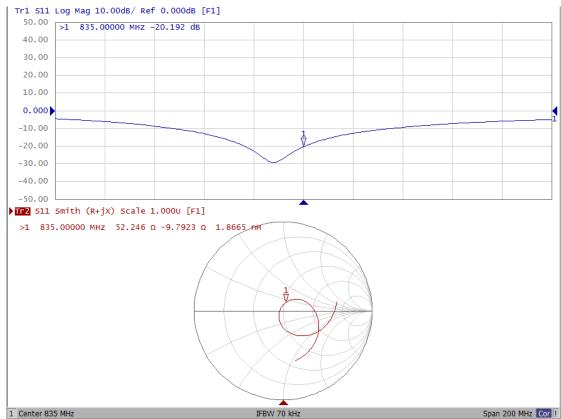
Referring to KDB865664 D01, if dipoles are verified in return loss(< -20dB, within 20% of prior calibration), and in impedance(within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

Justification of th						
		I	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

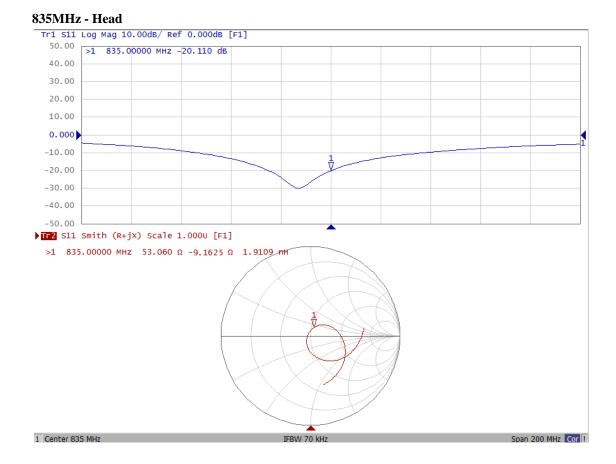
### Justification of the extended calibration

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

CALIBRATIC	N LABORATORY		BRATION
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Client BACL	Section 2	Certificate No: 24J0	2Z000371
CALIBRATION CI	ERTIFICAT	E	
Dbject	D1750	V2 - SN: 1141	
Calibration Procedure(s)	EE 711	I-003-01	
		ation Procedures for dipole validation kits	
Calibration date:		7, 2024	
Valibration date.	Julie	1,2024	
numidity<70%.		the closed laboratory facility: environment te	emperature (22±3)°C and
numidity<70%. Calibration Equipment used		for calibration)	
numidity<70%. Calibration Equipment used	I (M&TE critical f		
numidity<70%. Calibration Equipment used Primary Standards	I (M&TE critical f	for calibration) Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
uumidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2	I (M&TE critical f ID # 106276	for calibration) Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107)	Scheduled Calibration May-25
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A	I (M&TE critical f ID # 106276 101369	for calibration) Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107)	Scheduled Calibration May-25 May-25
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4	ID # 106276 101369 SN 7307	for calibration) Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24)	Scheduled Calibration May-25 May-25 May-25
numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4	ID # 106276 101369 SN 7307 SN 1556	for calibration) Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24) 03-Jan-24(CTTL-SPEAG, No.24J02Z80002)	Scheduled Calibration May-25 May-25 May-25 Jan-25
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	I (M&TE critical f ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430 MY46110673	for calibration) Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24) 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) Cal Date (Calibrated by, Certificate No.) 25-Dec-23 (CTTL, No. J23X13426) 25-Dec-23 (CTTL, No. J23X13425)	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24 Dec-24
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430	for calibration) Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24) 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) Cal Date (Calibrated by, Certificate No.) 25-Dec-23 (CTTL, No. J23X13426)	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	I (M&TE critical f ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430 MY46110673	for calibration) Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24) 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) Cal Date (Calibrated by, Certificate No.) 25-Dec-23 (CTTL, No. J23X13426) 25-Dec-23 (CTTL, No. J23X13425)	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24 Dec-24
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C OCP DAK-3.5(weighted)	ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430 MY46110673 1040	for calibration) Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24) 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) Cal Date (Calibrated by, Certificate No.) 25-Dec-23 (CTTL, No. J23X13426) 25-Dec-23 (CTTL, No. J23X13425) 22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24)	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24 Dec-24 Jan-25
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C OCP DAK-3.5(weighted)	I (M&TE critical f ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430 MY46110673 1040 Name	for calibration) Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24) 03-Jan-24(SPEAG, No. EX-7307_May24) 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) Cal Date (Calibrated by, Certificate No.) 25-Dec-23 (CTTL, No. J23X13426) 25-Dec-23 (CTTL, No. J23X13425) 22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24) Function	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24 Dec-24 Jan-25
Aumidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C OCP DAK-3.5(weighted) Calibrated by: Reviewed by:	I (M&TE critical f ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430 MY46110673 1040 Name Zhao Jing	for calibration) Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24) 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) Cal Date (Calibrated by, Certificate No.) 25-Dec-23 (CTTL, No. J23X13426) 25-Dec-23 (CTTL, No. J23X13425) 22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24) Function SAR Test Engineer	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24 Dec-24 Jan-25
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	I (M&TE critical f ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430 MY46110673 1040 Name Zhao Jing Lin Jun	for calibration) Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24) 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) Cal Date (Calibrated by, Certificate No.) 25-Dec-23 (CTTL, No. J23X13426) 25-Dec-23 (CTTL, No. J23X13425) 22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24) Function SAR Test Engineer SAR Test Engineer	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24 Dec-24 Jan-25 Signature





## 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
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- Feed Point Impedance and Return Loss: These parameters are measured with the dipole
  positioned under the liquid filled phantom. The impedance stated is transformed from the
  measurement at the SMA connector to the feed point. The Return Loss ensures low
  reflected power. No uncertainty required.
- Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- · SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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

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## **Measurement Conditions**

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

DASY Version	DASY52	52.10.4
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	40.7 ± 6 %	1.40 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	9.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.1 W/kg ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	4.88 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.4 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	47.2Ω- 0.96jΩ	
Return Loss	- 30.3dB	

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

Electrical Delay (one direction)	1.130 ns

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

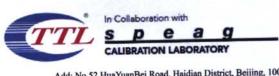
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching 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: 24J02Z000371

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

Date: 2024-06-17

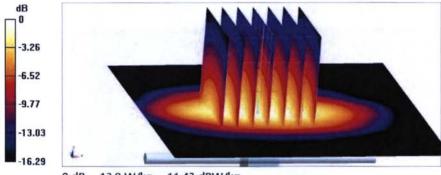
Test Laboratory: C11L, Beijing, China **DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1141** Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1750 MHz;  $\sigma = 1.401$  S/m;  $\varepsilon_r = 40.73$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN7307; ConvF(7.9, 7.9, 8.54) @ 1750 MHz; Calibrated: 2024-05-28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2024-01-03
- 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 = 96.89 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 16.2 W/kg SAR(1 g) = 9.11 W/kg; SAR(10 g) = 4.88 W/kg Smallest distance from peaks to all points 3 dB below = 9.8 mm Ratio of SAR at M2 to SAR at M1 = 56.9%

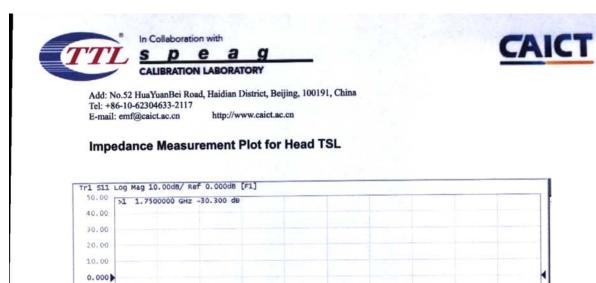
Maximum value of SAR (measured) = 13.9 W/kg



0 dB = 13.9 W/kg = 11.43 dBW/kg

Certificate No: 24J02Z000371

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## Certificate No: 24J02Z000371

1 Start 1.55 GHz

-10.00 -20.00 -30.00 -40.00

SIL Smith (R+jx) scale 1.000U [FL De]] >1 1.7500000 GHz 47.192 D -964.76 mD 94.268 pF

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IFEW 100 Hz

to 1.95 GHz

	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

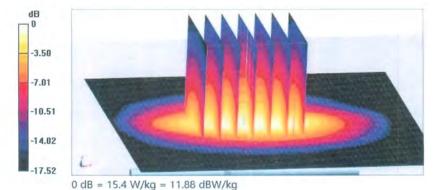
**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 543** Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz;  $\sigma = 1.388$  S/m;  $\varepsilon_r = 40.5$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Right Section Measurement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

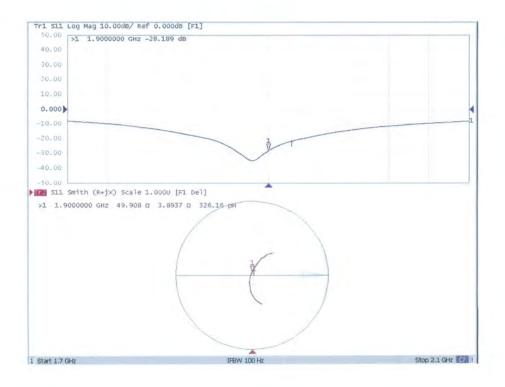


Certificate No: Z22-60478

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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

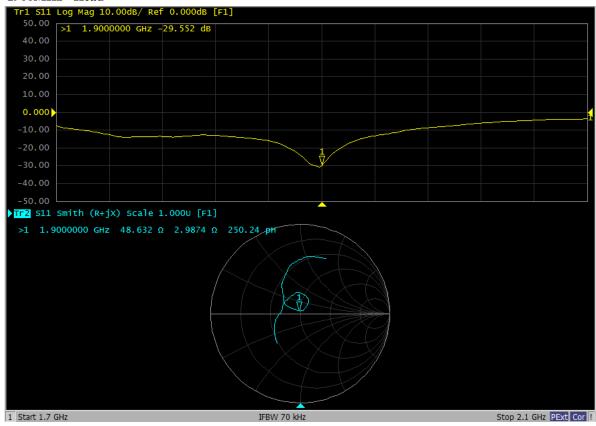
Referring to KDB865664 D01, if dipoles are verified in return loss(< -20dB, within 20% of prior calibration), and in impedance(within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

D1900V2 - SN:543						
1900MHz Head						
Date of Measurement	Return-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

Add: No.52 HuaYuanBei Ro Tel: +86-10-62304633-2117 E-mail: cttl@chinattl.com			BRATION S L0570
		ict.ac.cn	
Client BACL			2Z000372
CALIBRATION C	EDTIEICAT		
CALIBRATION	EKTIFICA		
Object	D2450	V2 - SN: 971	
Calibration Procedure(s)	FF-Z11	-003-01	
	Calibra	tion Procedures for dipole validation kits	
Calibration date:	June 1	5, 2024	
nere an ere de la competition de CATAN	Valid I		
This calibration Certificate	documents the	traceability to national standards, which realize	ze the physical units o
measurements (SI). The me	easurements and	the uncertainties with confidence probability and	e given on the following
bages and are part of the co	ertificate.		
		the closed laboratory facility: environment te	mperature (22±3)℃ and
Calibration Equipment used	d (M&TE critical f	or calibration)	
Calibration Equipment used	d (M&TE critical f	or calibration) Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Calibration Equipment used Primary Standards Power Meter NRP2	ID # 106276	Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107)	Scheduled Calibration May-25
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A	ID # 106276 101369	Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107)	Scheduled Calibration May-25 May-25
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4	ID # 106276 101369 SN 7307	Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24)	Scheduled Calibration May-25 May-25 May-25
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A	ID # 106276 101369	Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107)	Scheduled Calibration May-25 May-25
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4	ID # 106276 101369 SN 7307	Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24)	Scheduled Calibration May-25 May-25 May-25
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4	ID # 106276 101369 SN 7307 SN 1556	Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24) 03-Jan-24(CTTL-SPEAG, No.24J02Z80002)	Scheduled Calibration May-25 May-25 May-25 Jan-25
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards	ID # 106276 101369 SN 7307 SN 1556 ID #	Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24) 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) Cal Date (Calibrated by, Certificate No.) 25-Dec-23 (CTTL, No. J23X13426) 25-Dec-23 (CTTL, No. J23X13425)	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24 Dec-24
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430	Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24) 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) Cal Date (Calibrated by, Certificate No.) 25-Dec-23 (CTTL, No. J23X13426)	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	D (M&TE critical f ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430 MY46110673 1040	Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24) 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) Cal Date (Calibrated by, Certificate No.) 25-Dec-23 (CTTL, No. J23X13426) 25-Dec-23 (CTTL, No. J23X13425) 22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24)	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24 Dec-24 Jan-25
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C OCP DAK-3.5(weighted)	ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430 MY46110673 1040 Name	Cal Date (Calibrated by, Certificate No.)         17-May-24 (CTTL, No. J24X04107)         17-May-24 (CTTL, No. J24X04107)         28-May-24(SPEAG, No. EX-7307_May24)         03-Jan-24(CTTL-SPEAG, No.24J02Z80002)         Cal Date (Calibrated by, Certificate No.)         25-Dec-23 (CTTL, No. J23X13426)         25-Dec-23 (CTTL, No. J23X13425)         22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24)	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24 Dec-24
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C OCP DAK-3.5(weighted)	D (M&TE critical f ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430 MY46110673 1040	Cal Date (Calibrated by, Certificate No.) 17-May-24 (CTTL, No. J24X04107) 17-May-24 (CTTL, No. J24X04107) 28-May-24(SPEAG, No. EX-7307_May24) 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) Cal Date (Calibrated by, Certificate No.) 25-Dec-23 (CTTL, No. J23X13426) 25-Dec-23 (CTTL, No. J23X13425) 22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24)	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24 Dec-24 Jan-25
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C OCP DAK-3.5(weighted)	d (M&TE critical f ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430 MY46110673 1040 Name Zhao Jing	Cal Date (Calibrated by, Certificate No.)         17-May-24 (CTTL, No. J24X04107)         17-May-24 (CTTL, No. J24X04107)         28-May-24(SPEAG, No. EX-7307_May24)         03-Jan-24(CTTL-SPEAG, No.24J02Z80002)         Cal Date (Calibrated by, Certificate No.)         25-Dec-23 (CTTL, No. J23X13426)         25-Dec-23 (CTTL, No. J23X13425)         22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24)         Function         SAR Test Engineer	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24 Dec-24 Jan-25
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C OCP DAK-3.5(weighted)	ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430 MY46110673 1040 Name	Cal Date (Calibrated by, Certificate No.)         17-May-24 (CTTL, No. J24X04107)         17-May-24 (CTTL, No. J24X04107)         28-May-24(SPEAG, No. EX-7307_May24)         03-Jan-24(CTTL-SPEAG, No.24J02Z80002)         Cal Date (Calibrated by, Certificate No.)         25-Dec-23 (CTTL, No. J23X13426)         25-Dec-23 (CTTL, No. J23X13425)         22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24)	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24 Dec-24 Jan-25
Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	d (M&TE critical f ID # 106276 101369 SN 7307 SN 1556 ID # MY49071430 MY46110673 1040 Name Zhao Jing	Cal Date (Calibrated by, Certificate No.)         17-May-24 (CTTL, No. J24X04107)         17-May-24 (CTTL, No. J24X04107)         28-May-24(SPEAG, No. EX-7307_May24)         03-Jan-24(CTTL-SPEAG, No.24J02Z80002)         Cal Date (Calibrated by, Certificate No.)         25-Dec-23 (CTTL, No. J23X13426)         25-Dec-23 (CTTL, No. J23X13425)         22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24)         Function         SAR Test Engineer	Scheduled Calibration May-25 May-25 Jan-25 Scheduled Calibration Dec-24 Dec-24 Jan-25

Certificate No: 24J02Z000372

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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: 24J02Z000372

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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	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	39.1 ± 6 %	1.80 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	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.7 W/kg ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.8 W/kg ± 18.7 % (k=2)

Certificate No: 24J02Z000372

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.3Ω+ 6.84jΩ	
Return Loss	- 23.0dB	

## **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.063 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**

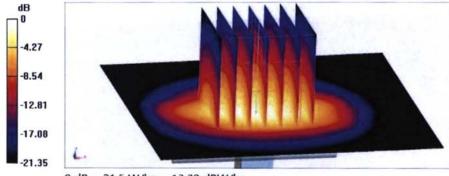
Date: 2024-06-15

Test Laboratory: CTTL, Beijing, China **DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 971** Communication System: UID 0, CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz;  $\sigma = 1.804$  S/m;  $\epsilon_r = 39.05$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN7307; ConvF(7.37, 7.34, 7.95) @ 2450 MHz; Calibrated: 2024-05-28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2024-01-03
- 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 = 99.31 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 25.9 W/kg SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.2 W/kg Smallest distance from peaks to all points 3 dB below = 8.5 mm Ratio of SAR at M2 to SAR at M1 = 51.8% Maximum value of SAR (measured) = 21.5 W/kg



0 dB = 21.5 W/kg = 13.32 dBW/kg

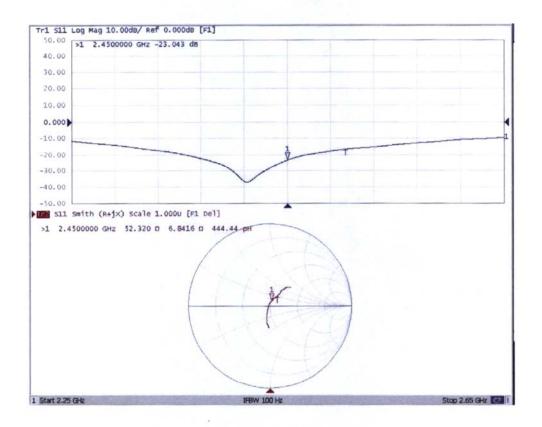
Certificate No: 24J02Z000372

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Impedance Measurement Plot for Head TSL



Certificate No: 24J02Z000372

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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	
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I calibrations have been umidity<70%.	conducted in t	he closed laboratory facility: environment t or calibration)	emperature (22±3)°C and
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Il calibrations have been umidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A	rtificate. conducted in the conducted for the conduc	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103)	Scheduled Calibration May-23
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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 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%.

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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

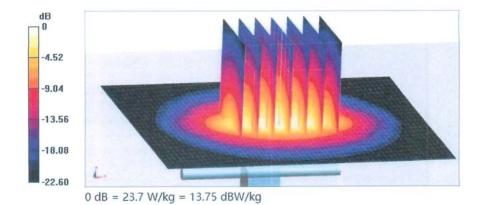
**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1132** Communication System: UID 0, CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz;  $\sigma = 1.974$  S/m;  $\varepsilon_r = 39.04$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Right Section Measurement Standard: DASY5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

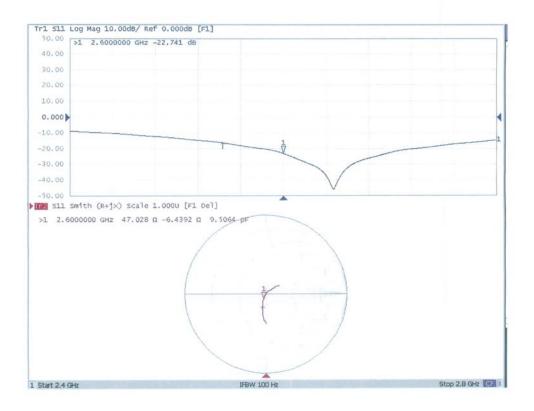


Certificate No: Z22-60479

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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

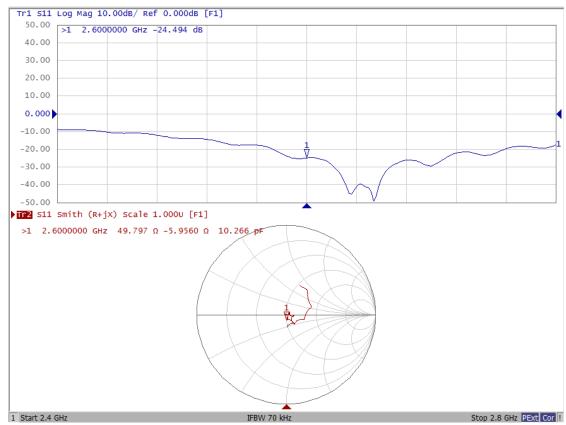
Referring to KDB 865664 D01, if dipoles are verified in return loss(< -20dB, within 20% of prior calibration), and in impedance(within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

D2600V2 - SN:1132						
			2600MHz Head			
Date of Measurement	Return-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

Certificate No: Z22-60480

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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: Z22-60480

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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

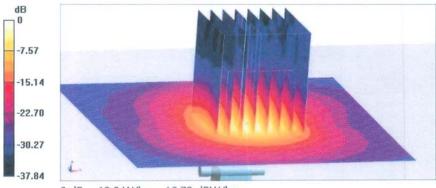
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Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 63.56 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 36.7 W/kg SAR(1 g) = 7.89 W/kg; SAR(10 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

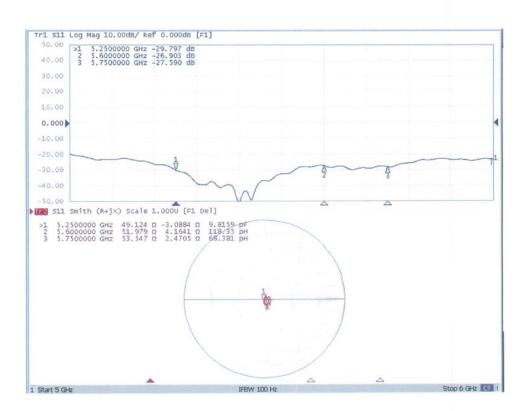
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Impedance Measurement Plot for Head TSL



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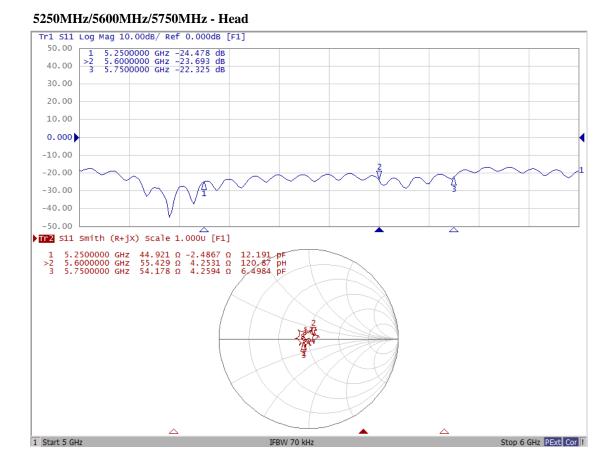
## D5GHzV2 - SN:1246 Extended Dipole Calibrations

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