





Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191

Tel: +86-10-62304633-2117

E-mail: emf@caict.ac.cn

http://www.caic.ac.cn

Client

Morlab

Certificate No:

24J02Z000807

CALIBRATION CERTIFICATE

Object

D5GHzV2 - SN: 1176

Calibration Procedure(s)

FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date:

October 22, 2024

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID#	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106276	17-May-24 (CTTL, No. J24X04107)	May-25
Power sensor NRP6A	101369	17-May-24 (CTTL, No. J24X04107)	May-25
Reference Probe EX3DV4	SN 7517	21-Feb-24(CTTL-SPEAG, No. 24J02Z000713)	Feb-25
DAE4	SN 1588	13-Sep-24(CTTL-SPEAG, No. 24J02Z000713)	Sep-25
Secondary Standards	ID#	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	25-Dec-23 (CTTL, No. J23X13426)	Dec-24
NetworkAnalyzer E5071C	MY46110673	25-Dec-23 (CTTL, No. J23X13425)	Dec-24
OCP DAK-3.5(weighted)	1040	22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24)	Jan-25

Name

Function

Signature

Calibrated by:

Zhao Jing

SAR Test Engineer

Q Z

Reviewed by:

Lin Jun

SAR Test Engineer

my

Approved by:

Qi Dianyuan

SAR Project Leader

Issued: October 30, 2024

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

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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:

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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 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 = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

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) °C	36.2 ± 6 %	4.67 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

SAR result with Head TSL at 5250MHz

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SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition			
SAR measured	100 mW input power	7.72 W/kg		
SAR for nominal Head TSL parameters	normalized to 1W	77.3 W/kg ± 24.4 % (<i>k</i> =2)		
SAR averaged over 10 $ cm^3 $ (10 g) of Head TSL	Condition			
SAR measured	100 mW input power	2.15 W/kg		
SAR for nominal Head TSL parameters	normalized to 1W	21.5 W/kg ± 24.2 % (<i>k</i> =2)		





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Head TSL parameters at 5600MHz

The following parameters and calculations were applied.

	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	35.6 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

SAR result with Head TSL at 5600MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.4 W/kg ± 24.4 % (<i>k</i> =2)
SAR averaged over 10 $$ cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.8 W/kg ± 24.2 % (<i>k</i> =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) °C	35.3 ± 6 %	5.21 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

SAR result with Head TSL at 5750MHz

IN 163ait With Head Tol at 0700iii iz		
SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.72 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.2 W/kg ± 24.4 % (<i>k</i> =2)
SAR averaged over 10 $ cm^3 $ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.2 W/kg ± 24.2 % (<i>k</i> =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	47.4Ω- 4.12jΩ
Return Loss	- 26.0dB

Antenna Parameters with Head TSL at 5600MHz

Impedance, transformed to feed point	53.5Ω+ 0.01jΩ	
Return Loss	- 29.4dB	

Antenna Parameters with Head TSL at 5750MHz

Impedance, transformed to feed point	51.4Ω- 1.90jΩ
Return Loss	- 32.7dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.015 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

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1176

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz,

Frequency: 5750 MHz

Medium parameters used: f = 5250 MHz; σ = 4.669 S/m; ϵ_r = 36.17; ρ = 1000 kg/m³ Medium parameters used: f = 5600 MHz; σ = 5.046 S/m; ϵ_r = 35.56; ρ = 1000 kg/m³ Medium parameters used: f = 5750 MHz; σ = 5.209 S/m; ϵ_r = 35.34; ρ = 1000 kg/m³

Phantom section: Right Section

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

DASY5 Configuration:

Probe: EX3DV4 - SN7517; ConvF(5.43, 5.43, 5.43) @ 5250 MHz;
 ConvF(4.83, 4.83, 4.83) @ 5600 MHz; ConvF(4.95, 4.95, 4.95) @ 5750 MHz; Calibrated: 2024-02-21

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1588; Calibrated: 2024-09-13

 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 = 65.08 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 31.5 W/kg

SAR(1 g) = 7.72 W/kg; SAR(10 g) = 2.15 W/kg

Smallest distance from peaks to all points 3 dB below = 6.8 mm

Ratio of SAR at M2 to SAR at M1 = 65.1%

Maximum value of SAR (measured) = 18.3 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 = 65.59 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 37.6 W/kg

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SAR(1 g) = 8.24 W/kg; SAR(10 g) = 2.28 W/kg

Smallest distance from peaks to all points 3 dB below = 6.8 mm

Ratio of SAR at M2 to SAR at M1 = 61.6%

Maximum value of SAR (measured) = 20.4 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 = 62.40 V/m; Power Drift = 0.00 dB

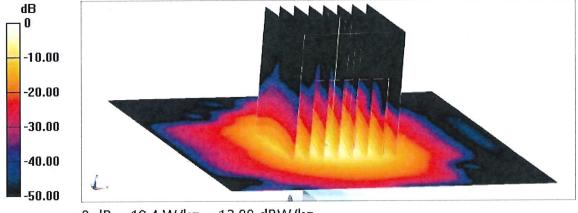
Peak SAR (extrapolated) = 36.8 W/kg

SAR(1 g) = 7.72 W/kg; SAR(10 g) = 2.12 W/kg

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 59.8%

Maximum value of SAR (measured) = 19.4 W/kg



0 dB = 19.4 W/kg = 12.88 dBW/kg



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Impedance Measurement Plot for Head TSL

