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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 = 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 ℃	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) ℃	36.3 ± 6 %	4.64 mho/m ± 6 %
Head TSL temperature change during test	<1.0 ℃	---	---

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	7.92 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.4 W/kg ± 24.4 % (*k*=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.7 W/kg ± 24.2 % (*k*=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 ℃	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ±0.2) ℃	35.2 ±6 %	5.01 mho/m ±6 %
Head TSL temperature change during test	<1.0 ℃	----	----

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	8.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**81.5 W/kg ±24.4 % (*k*=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.3 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 ℃	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ±0.2) ℃	35.0 ±6 %	5.18 mho/m ±6 %
Head TSL temperature change during test	<1.0 ℃	----	----

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	7.92 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**79.0 W/kg ±24.4 % (*k*=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.3 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	48.5Ω- 2.67jΩ
Return Loss	- 30.1dB

Antenna Parameters with Head TSL at 5600MHz

Impedance, transformed to feed point	52.6Ω+ 4.03jΩ
Return Loss	- 26.6dB

Antenna Parameters with Head TSL at 5750MHz

Impedance, transformed to feed point	49.2Ω+ 3.02jΩ
Return Loss	- 30.1dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.105 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: 2022-08-17

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1296

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz Duty Cycle: 1:1

Medium parameters used: f = 5250 MHz; σ = 4.643 S/m; ε_r = 36.34; ρ = 1000 kg/m^3

Medium parameters used: f = 5600 MHz; σ = 5.006 S/m; ε_r = 35.17; ρ = 1000 kg/m^3

Medium parameters used: f = 5750 MHz; σ = 5.18 S/m; ε_r = 34.96; ρ = 1000 kg/m^3

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 = 67.40 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 31.7 W/kg

SAR(1 g) = 7.92 W/kg; SAR(10 g) = 2.26 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 65.3%

Maximum value of SAR (measured) = 18.5 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 = 70.34 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 34.3 W/kg

SAR(1 g) = 8.17 W/kg; SAR(10 g) = 2.34 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 63.4%

Maximum value of SAR (measured) = 19.0 W/kg

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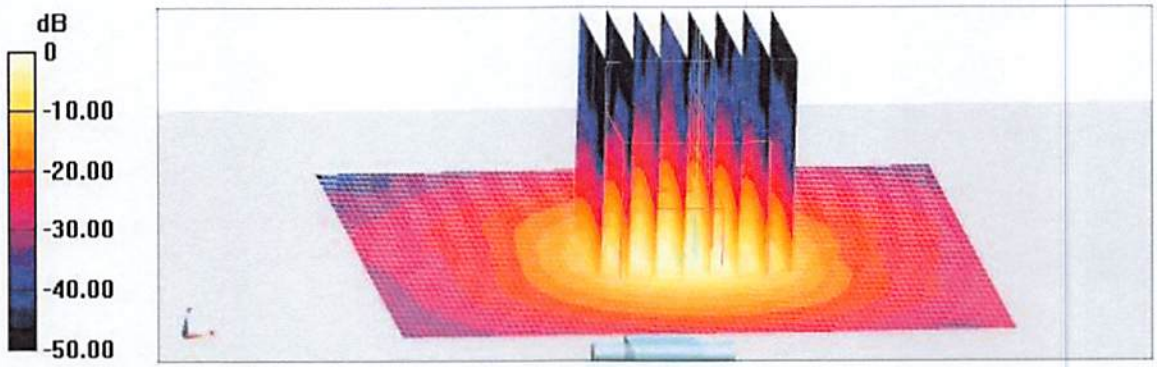
Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.13 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 35.8 W/kg
SAR(1 g) = 7.92 W/kg; SAR(10 g) = 2.24 W/kg
Smallest distance from peaks to all points 3 dB below = 7.5 mm
Ratio of SAR at M2 to SAR at M1 = 61.5%
Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 19.2 W/kg = 12.83 dBW/kg

In Collaboration with
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CALIBRATION LABORATORY

CAICT

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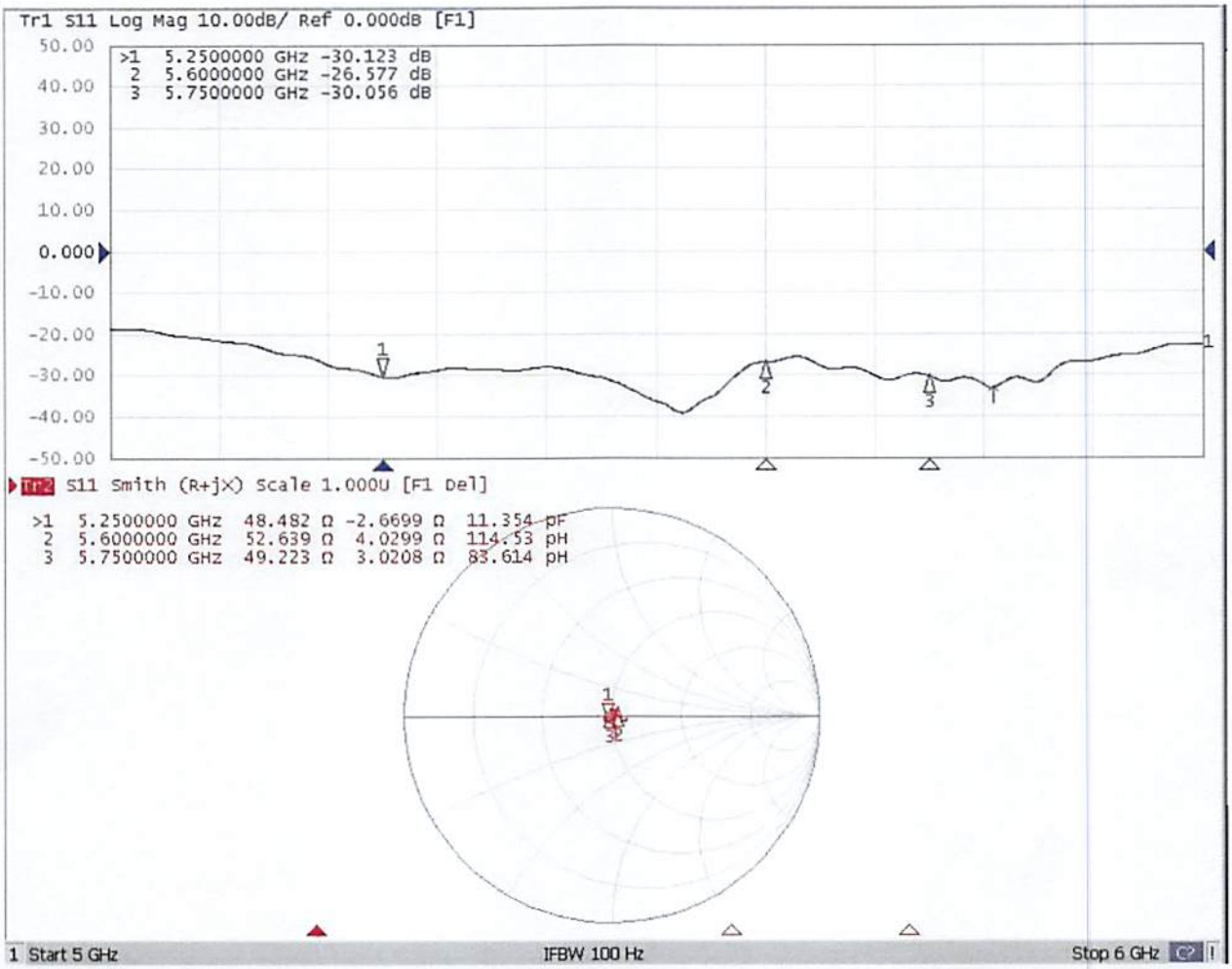
Impedance Measurement Plot for Head TSL



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Dipole Intermediate Check

Justification for Extended SAR Dipole Calibrations
Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in **KDB 865664 D01**:

Test Date: 2023/08/19

750 MHz

Dipole D750V3 SN: 1166				
Head Liquid				
Test By: Jason Liu		**Checked By:** Bard Liu		
Date of Measurement	***Return Loss(dB)***	**Δ%**	***Impedance (Ω)***	**ΔΩ**
2021/08/31	-26.0	N/A	53.0	N/A
2022/06/25	-24.5	5.769	52.3	0.7
2023/08/19	-25.1	3.462	54.2	1.2

Dipole Intermediate Check

Justification for Extended SAR Dipole Calibrations
Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in **KDB 865664 D01**:

Test Date: 2023.06.18

1750 MHz

Dipole D1750V2 SN: 1140				
Head Liquid				
Test By: Jason Lu		Checked By: Bard Liu		
Date of Measurement	**Return Loss(dB)**	**Δ%**	**Impedance (Ω)**	**ΔΩ**
2021/06/29	-32.0	N/A	51.6	N/A
2022/06/22	-31.5	1.563	50.2	1.4
2023/06/18	-31	2.583	52.6	2.4

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Dipole Intermediate Check

Justification for Extended SAR Dipole Calibrations
Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in **KDB 865664 D01**:

Test Date: 2023.08.22

1900 MHz

Dipole D1900V2 SN: 5d206				
Head Liquid				
Test By: Jason Lu		Checked By: Bard Liu		
Date of Measurement	Return Loss(dB)	Δ%	Impedance (Ω)	ΔΩ
2021.09.01	-23.1	N/A	54.6	N/A
2022.06.26	-22.5	2.597	53.4	1.4
2023.08.22	-22.2	3.896	52.6	2.0

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Dipole Intermediate Check

Justification for Extended SAR Dipole Calibrations
Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in **KDB 865664 D01**:

Test Date: 2023.06.15

2450 MHz

Dipole D2450V2 SN: 970				
Head Liquid				
Test By: Jason Lu		Checked By: Bard Liu		
Date of Measurement	Return Loss(dB)	Δ%	Impedance (Ω)	ΔΩ
2021.06.28	-24.8	N/A	55.8	N/A
2022.06.18	-24.3	2.016	54.4	1.4
2023.06.15	-23.4	5.645	53.8	2.0

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Dipole Intermediate Check

Justification for Extended SAR Dipole Calibrations
Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in **KDB 865664 D01**:

Test Date: 2023.8.18

260 MHz

Dipole D260V2 SN: 1162				
Head Liquid				
Test By: Jason Lu		Checked By: Bard Liu		
Date of Measurement	Return Loss(dB)	Δ%	Impedance (Ω)	ΔΩ
2022.08.22	-23.2	N/A	47.7	N/A
2023.08.18	-22.4	3.448	46.5	1.2

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Dipole Intermediate Check

Justification for Extended SAR Dipole Calibrations
Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in **KDB 865664 D01**:

Test Date: 2023.08.12

5250 MHz

Dipole D5GHzV2 SN: 1296				
Head Liquid				
Test By: Jason Liu		Checked By: Bard Liu		
Date of Measurement	Return Loss(dB)	Δ%	Impedance (Ω)	ΔΩ
2022.08.17	-32.1	N/A	48.5	N/A
2023.08.12	-28.9	3.987	47.2	1.3

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Dipole Intermediate Check

Justification for Extended SAR Dipole Calibrations
Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in **KDB 865664 D01**:

Test Date: 2023.8.12

5750 MHz

Dipole D5GHzV2 SN: 1296				
Head Liquid				
Test By: Jason Lu		Checked By: Bard Lin		
Date of Measurement	**Return Loss(dB)**	**Δ%**	**Impedance (Ω)**	**ΔΩ**
2022.08.17	-30.1	N/A	49.2	N/A
2023.08.12	-29.4	2.326	48.1	1.1

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Dipole Intermediate Check

Justification for Extended SAR Dipole Calibrations
Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in **KDB 865664 D01**:

Test Date: 2024/01/30

835 MHz

Dipole D835 V2 SN: 445				
Head Liquid				
Test By: Jason Lin		Checked By: Bard Liu		
Date of Measurement	Return Loss(dB)	Δ%	Impedance (Ω)	ΔΩ
2023/02/10	-21.8	N/A	51.9	N/A
2024/01/30	-20.4	6.42	51.3	0.6