Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.3 Ω + 5.6 jΩ	
Return Loss	- 24.5 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 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

DASY5 Validation Report for Head TSL

Date: 25.04.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d179

Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; σ = 1.4 S/m; ϵ_r = 41.1; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.43, 8.43, 8.43) @ 1900 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 109.3 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 18.2 W/kg **SAR(1 g) = 9.80 W/kg; SAR(10 g) = 5.14 W/kg** Smallest distance from peaks to all points 3 dB below = 9.1 mm Ratio of SAR at M2 to SAR at M1 = 55% Maximum value of SAR (measured) = 15.1 W/kg



0 dB = 15.1 W/kg = 11.78 dBW/kg



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Client

BTL Inc. Guangdong Certificate No.

CRE

D2300V2-1033_Sep24

CALIBRATION CERTIFICATE

Object	D2300V2 - SN: 1033
Calibration procedure(s)	QA CAL-05.v12
	Calibration Procedure for SAR Validation Sources between 0.7 - 3 GHz
Calibration date	September 13, 2024
This calibration certificate doo The measurements and the u	cuments the traceability to national standards, which realize the physical units of measurements (SI).
All calibrations have been cor	nducted in the closed laboratory facility: environment temperature $(22+3)^{\circ}$ C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Cal
Power Sensor R&S NRP-33T	SN: 100967	28-Mar-24 (No. 217-04038)	Mar-25
Power Sensor R&S NRP18A	SN: 101859	22-Jul-24 (No. 4030A315008547)	Jul-25
Spectrum Analyzer R&S FSV40	SN: 101832	25-Jan-24 (No. 4030-315007551)	Jan-25
Mismatch; Short [S4188] Attenuator [S4423]	SN: 1152	28-Mar-24 (No. 217-04050)	Mar-25
OCP DAK-12	SN: 1016	05-Oct-23 (No. OCP-DAK12-1016_Oct23)	Oct-24
OCP DAK-3.5	SN: 1249	05-Oct-23 (No. OCP-DAK3.5-1249_Oct23)	Oct-24
Reference Probe EX3DV4	SN: 7349	03-Jun-24 (No. EX3-7349_Jun24)	Jun-25
DAE4ip	SN: 1836	10-Jan-24 (No. DAE4ip-1836_Jan24)	Jan-25

Secondary Standards	ID	Check Date (in house)	Scheduled Check
ACAD Source Box	SN: 1000	28-May-24 (No. 675-ACAD_Source_Box-240528)	May-25
Signal Generator R&S SMB100A	SN: 182081	28-May-24 (No. 675-CAL16-S4588-240528)	May-25
Mismatch; SMA	SN: 1102	22-May-24 (No. 675-Mismatch_SMA-240522)	May-25

Name Function Signature Calibrated by Paulo Pina Laboratory Technician Approved by Sven Kühn Technical Manager Issued: September 16, 2024 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

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Accreditation No.: SCS 0108

Glossary

TSL tissue simulating liquid ConvF sensitivity in TSL / NORM x,y,z N/A not applicable or not measured

Calibration is Performed According to the Following Standards

- 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-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- · KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation

DASY 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%.

Measurement Conditions

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

DASY Version	DASY8 Module SAR	16.4.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with spacer
Zoom Scan Resolution	dx, dy = 5mm, dz = 1.5mm	Graded Ratio = 1.5 mm (Z direction)
Frequency	2300MHz ±1MHz	

Head TSL parameters at 2300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.5	1.67 mho/m
Measured Head TSL parameters	(22.0 ±0.2)°C	38.4 ±6%	1.69 mho/m ±6%
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 2300 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	24 dBm input power	12.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	49.8 W/kg ±17.0% (k = 2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	24 dBm input power	6.03 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.0 W/kg ±16.5% (k = 2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 2300 MHz

Impedance	48.9 Ω – 4.0 jΩ
Return Loss	-27.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.172 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured. The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
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System Performance Check Report

Summary							
Dipole			Frequency [MH	lz] TSL	Power [dBm]		
D2300V2 - SN1033			2300	HSL	24		
Exposure Condition	S						
Phantom Section, TSL	Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat	10		CW, 0	2300, 0	7.49	1.69	38.4
Hardware Setup							
Phantom	TSL, Measured Date Probe, Calibration Date		bbe, Calibration Date	DAE,	Calibration Date		
MFP V8.0 Right	HSL, 2024–09–13 EX3DV4 – SN7		3DV4 - SN7349, 2024-06-03	DAE4	ip Sn1836, 2024-01-10		

Scans Setup		Measurement Results	
	Zoom Scan		Zoom Scan
Grid Extents [mm]	30 x 30 x 30	Date	2024-09-13
Grid Steps [mm]	5.0 x 5.0 x 1.5	psSAR1g [W/Kg]	12.5
Sensor Surface [mm]	1.4	psSAR10g [W/Kg]	6.03
Graded Grid	Yes	Power Drift [dB]	0.00
Grading Ratio	1.5	Power Scaling	Disabled
MAIA	N/A	Scaling Factor [dB]	
Surface Detection	VMS + 6p	TSL Correction	Positive / Negative
Scan Method	Measured		



0 dB = 24.7 W/Kg

Impedance Measurement Plot for Head TSL



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Client BTL Inc. Guangdong

Certificate No. D2450V2-919_Apr24/2

CALIBRATION CERTIFICATE (Replacement of No: D2450V2-919_Apr24)

Object

D2450V2 - SN:919

Calibration procedure(s)

QA CAL-05.v12 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date:

April 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)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25
Power sensor NRP-Z91	SN: 103244	26-Mar-24 (No. 217-04036)	Mar-25
Power sensor NRP-Z91	SN: 103245	26-Mar-24 (No. 217-04037)	Mar-25
Reference 20 dB Attenuator	SN: BH9394 (20k)	26-Mar-24 (No. 217-04046)	Mar-25
Type-N mismatch combination	SN: 310982 / 06327	26-Mar-24 (No. 217-04047)	Mar-25
Reference Probe EX3DV4	SN: 7349	03-Nov-23 (No. EX3-7349_Nov23)	Nov-24
DAE4	SN: 601	30-Jan-24 (No. DAE4-601_Jan24)	Jan-25
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24
	Name	Function	Signature
Calibrated by:	Joanna Lleshaj	Laboratory Technician	Attallese
Approved by:	Sven Kühn	Technical Manager	Sin
			Issued: May 21, 2024

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,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-Worn 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) DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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%.

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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	38.0 ± 6 %	1.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.1 W/kg ± 17.0 % (k=2)
SAB averaged over 10 cm ³ (10 c) of Head TSI	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	6 30 W/kg

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.3 Ω + 1.3 jΩ	
Return Loss	- 25.7 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.157 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
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Date: 22.04.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:919

Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; σ = 1.87 S/m; ϵ_r = 38; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.96, 7.96, 7.96) @ 2450 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 119.3 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 27.2 W/kg **SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.3 W/kg** Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 50.1% Maximum value of SAR (measured) = 22.4 W/kg



Impedance Measurement Plot for Head TSL



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Client BTL Inc. Guangdong

Certificate No. D2600V2-1067_Apr24/2

CALIBRATION CERTIFICATE (Replacement of No: D2600V2-1067) Apr24

Object

D2600V2 - SN:1067

Calibration procedure(s)

QA CAL-05.v12 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date:

April 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)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

ID #	Cal Date (Certificate No.)	Scheduled Calibration
SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25
SN: 103244	26-Mar-24 (No. 217-04036)	Mar-25
SN: 103245	26-Mar-24 (No. 217-04037)	Mar-25
SN: BH9394 (20k)	26-Mar-24 (No. 217-04046)	Mar-25
SN: 310982 / 06327	26-Mar-24 (No. 217-04047)	Mar-25
SN: 7349	03-Nov-23 (No. EX3-7349_Nov23)	Nov-24
SN: 601	30-Jan-24 (No. DAE4-601_Jan24)	Jan-25
ID #	Check Date (in house)	Scheduled Check
SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24
Name	Function	Signature
Joanna Lleshaj	Laboratory Technician	Hullink
Sven Kühn	Technical Manager	Cultures
	ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477 Name Joanna Lleshaj Sven Kühn	ID # Cal Date (Certificate No.) SN: 104778 26-Mar-24 (No. 217-04036/04037) SN: 103244 26-Mar-24 (No. 217-04036) SN: 103245 26-Mar-24 (No. 217-04036) SN: 103245 26-Mar-24 (No. 217-04037) SN: BH9394 (20k) 26-Mar-24 (No. 217-04046) SN: 310982 / 06327 26-Mar-24 (No. 217-04047) SN: 7349 03-Nov-23 (No. EX3-7349_Nov23) SN: 601 30-Jan-24 (No. DAE4-601_Jan24) ID # Check Date (in house) SN: GB39512475 30-Oct-14 (in house check Oct-22) SN: MY41093315 07-Oct-15 (in house check Oct-22) SN: 100972 15-Jun-15 (in house check Oct-22) SN: 100972 15-Jun-15 (in house check Oct-22) SN: US41080477 31-Mar-14 (in house check Oct-22) Name Function Joanna Lleshaj Laboratory Technician Sven Kühn Technical Manager

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,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-Worn 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) DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss: This parameter is measured with the source positioned under the liquid filled . phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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%.

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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) °C	37.4 ± 6 %	2.04 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	56.8 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.4 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.5 Ω - 7.1 jΩ	
Return Loss	- 22.2 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.150 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

DASY5 Validation Report for Head TSL

Date: 22.04.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1067

Communication System: UID 0 - CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz; σ = 2.04 S/m; ϵ_r = 37.4; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.84, 7.84, 7.84) @ 2600 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 119.3 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 29.2 W/kg **SAR(1 g) = 14.6 W/kg; SAR(10 g) = 6.45 W/kg** Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 49.6% Maximum value of SAR (measured) = 24.2 W/kg









Client

BTL Inc.

Certificate No:

Z23-60023

CALIBRATION CERTIFICATE

Object

D3500V2 - SN: 1095

January 10, 2023

Calibration Procedure(s)

FF-Z11-003-01 Calibration Procedures for dipole validation kits

Calibration date:

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)°C 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	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)	Jan-23
DAE4	SN 1556	12-Jan-22(CTTL-SPEAG,No.Z22-60007)	Jan-23
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	· · · ·
Reviewed by:	Lin Hao	SAR Test Engineer	林书
Approved by:	Qi Dianyuan	SAR Project Leader	25
		Issued: Janu	ary 18, 2023

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





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%.





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	3500 MHz ±1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.9	2.91 mho/m
Measured Head TSL parameters	(22.0 ±0.2) ℃	37.2 ±6 %	2.87 mho/m ±6 %
Head TSL temperature change during test	<1.0 ℃		

SAR result with Head TSL

SAR averaged over 1 Cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	65.6 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	2.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.2 W/kg ±24.2 % (<i>k</i> =2)





Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.1Ω+ 4.80jΩ
Return Loss	- 26.1dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.041 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 semingid 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





DASY5 Validation Report for Head TSLDate: 2023-01-10Test Laboratory: CTTL, Beijing, ChinaDUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN: 1095Communication System: UID 0, CW; Frequency: 3500 MHzMedium parameters used: f = 3500 MHz; σ = 2.866 S/m; ε_r = 37.23; ρ = 1000 kg/m³Phantom section: Right SectionMeasurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(7.2, 7.2, 7.2) @ 3500 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=3500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 64.38 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 16.7 W/kg SAR(1 g) = 6.56 W/kg; SAR(10 g) = 2.53 W/kg Smallest distance from peaks to all points 3 dB below = 8 mm Ratio of SAR at M2 to SAR at M1 = 76.6% Maximum value of SAR (measured) = 11.9 W/kg



0 dB = 11.9 W/kg = 10.76 dBW/kg





Impedance Measurement Plot for Head TSL







Client

BTL Inc.

Certificate No:

Z23-60024

CALIBRATION CERTIFICATE

Object

D3700V2 - SN: 1064

January 10, 2023

Calibration Procedure(s)

FF-Z11-003-01 Calibration Procedures for dipole validation kits

Calibration date:

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)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Qi Dianyuan

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
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)	Jan-23
DAE4	SN 1556	12-Jan-22(CTTL-SPEAG, No. Z22-60007)	Jan-23
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 he
Reviewed by:	Lin Hao	SAR Test Engineer	the sto
Approved by:		SAR Project Leader	51 -

Issued: January 18, 2023

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

SAR Project Leader





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%.





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	3700 MHz ±1 MHz	

Head TSL parameters at 3700 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.7	3.12 mho/m
Measured Head TSL parameters	(22.0 ±0.2) ℃	37.7 ±6 %	3.07 mho/m ±6 %
Head TSL temperature change during test	<1.0 ℃		

SAR result with Head TSL at 3700 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	65.8 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	2.44 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.4 W/kg ±24.2 % (<i>k</i> =2)





Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL at 3700 MHz

Impedance, transformed to feed point	47.9Ω +2.02jΩ
Return Loss	- 30.5dB

General Antenna Parameters and Design

Electrical Delay (one direction) 1.042 ns	
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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 TSLDate: 2023-01-10Test Laboratory: CTTL, Beijing, ChinaDUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN: 1064Communication System: UID 0, CW; Frequency: 3700 MHz;
Medium parameters used: f = 3700 MHz; σ = 3.072 S/m; ε_r = 37.66; ρ = 1000 kg/m³
Phantom section: Right Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(6.78, 6.78, 6.78) @ 3700 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=3700 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 63.51 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 17.5 W/kg SAR(1 g) = 6.56 W/kg; SAR(10 g) = 2.44 W/kg Smallest distance from peaks to all points 3 dB below = 8 mm Ratio of SAR at M2 to SAR at M1 = 75.4% Maximum value of SAR (measured) = 12.3 W/kg







Impedance Measurement Plot for Head TSL



TIFICAT D3900 FF-Z11 Calibra Januar	E 72 - SN: 1039 -003-01 tion Procedures for dipole validation kits	-00023
D3900V FF-Z11 Calibra Januar	/2 - SN: 1039 -003-01 tion Procedures for dipole validation kits	
D3900 FF-Z11 Calibra Januar	/2 - SN: 1039 -003-01 tion Procedures for dipole validation kits	
FF-Z11 Calibra Januar	-003-01 tion Procedures for dipole validation kits	
Januar		
	/ 11, 2023	
TE critical fe) #)6276	Cal Date (Calibrated by, Certificate No.) 10-May-22 (CTTL, No.J22X03103)	Scheduled Calibration May-23
01369	10-May-22 (CTTL, No.J22X03103)	May-23
N 7464 N 1555	26-Jan-22(SPEAG,No.EX3-7464_Jan22) 25-Aug-22(SPEAG,No.DAE4-1555_Aug22)	Jan-23 Aug-23
N 7464 N 1555)#	26-Jan-22(SPEAG,No.EX3-7464_Jan22) 25-Aug-22(SPEAG,No.DAE4-1555_Aug22) Cal Date (Calibrated by, Certificate No.)	Jan-23 Aug-23 Scheduled Calibration
N 7464 N 1555 # Y49071430 Y46110673	26-Jan-22(SPEAG,No.EX3-7464_Jan22) 25-Aug-22(SPEAG,No.DAE4-1555_Aug22) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409) 14-Jan-22 (CTTL, No.J22X00406)	Jan-23 Aug-23 Scheduled Calibration Jan-23 Jan-23
N 7464 N 1555 # Y49071430 Y46110673 lame	26-Jan-22(SPEAG,No.EX3-7464_Jan22) 25-Aug-22(SPEAG,No.DAE4-1555_Aug22) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409) 14-Jan-22 (CTTL, No.J22X00406) Function	Jan-23 Aug-23 Scheduled Calibration Jan-23 Jan-23 Signature
N 7464 N 1555 # Y49071430 Y46110673 lame ao Jing	26-Jan-22(SPEAG,No.EX3-7464_Jan22) 25-Aug-22(SPEAG,No.DAE4-1555_Aug22) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409) 14-Jan-22 (CTTL, No.J22X00406) Function SAR Test Engineer	Jan-23 Aug-23 Scheduled Calibration Jan-23 Jan-23 Signature
N 7464 N 1555 # Y49071430 Y46110673 lame ao Jing n Hao	26-Jan-22(SPEAG,No.EX3-7464_Jan22) 25-Aug-22(SPEAG,No.DAE4-1555_Aug22) Cal Date (Calibrated by, Certificate No.) 13-Jan-22 (CTTL, No.J22X00409) 14-Jan-22 (CTTL, No.J22X00406) Function SAR Test Engineer SAR Test Engineer	Jan-23 Aug-23 Scheduled Calibration Jan-23 Jan-23 Signature
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Glossary:

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

Calibration is Performed According to the Following Standards:

- a) 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%.





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	3900 MHz ±1 MHz	

Head TSL parameters at 3900MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.5	3.32 mho/m
Measured Head TSL parameters	(22.0 ±0.2) ℃	37.4 ±6 %	3.31 mho/m ±6 %
Head TSL temperature change during test	<1.0 ℃	-	

SAR result with Head TSL at 3900MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.89 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	68.9 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	2.44 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.4 W/kg ±24.2 % (<i>k</i> =2)





Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL at 3900MHz

Impedance, transformed to feed point	45.8Ω- 6.39jΩ
Return Loss	- 22.0dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.010 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 seminigid 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





DASY5 Validation Report for Head TSLDate: 2023-01-11Test Laboratory: CTTL, Beijing, ChinaDUT: Dipole 3900 MHz; Type: D3900V2; Serial: D3900V2 - SN: 1039Communication System: UID 0, CW; Frequency: 3900 MHzMedium parameters used: f = 3900 MHz; σ = 3.308 S/m; ϵ_r = 37.4; ρ = 1000 kg/m³Phantom section: Right SectionMeasurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)DASY5 Configuration:Date: 2023-01-11

- Probe: EX3DV4 SN7464; ConvF(6.76, 6.76, 6.76) @ 3900 MHz; Calibrated: 2022-01-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 2022-08-25
- 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=3900 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 70.87 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 18.3 W/kg SAR(1 g) = 6.89 W/kg; SAR(10 g) = 2.44 W/kg Smallest distance from peaks to all points 3 dB below = 7.9 mm Ratio of SAR at M2 to SAR at M1 = 75.9% Maximum value of SAR (measured) = 12.9 W/kg



0 dB = 12.9 W/kg = 11.11 dBW/kg





Impedance Measurement Plot for Head TSL



Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Client BTL Inc.

Guangdong

Certificate No. D5GHzV2-1160_Apr24/2

CALIBRATION CERTIFICATE (Replacement of No: D5GHzV2-1160_Apr24)

Object

D5GHzV2 - SN:1160

Calibration procedure(s)

QA CAL-22.v7 Calibration Procedure for SAR Validation Sources between 3-10 GHz

Calibration date:

April 25, 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)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

i minary otanuarus	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25
Power sensor NRP-Z91	SN: 103244	26-Mar-24 (No. 217-04036)	Mar-25
Power sensor NRP-Z91	SN: 103245	26-Mar-24 (No. 217-04037)	Mar-25
Reference 20 dB Attenuator	SN: BH9394 (20k)	26-Mar-24 (No. 217-04046)	Mar-25
Type-N mismatch combination	SN: 310982 / 06327	26-Mar-24 (No. 217-04047)	Mar-25
Reference Probe EX3DV4	SN: 3503	07-Mar-24 (No. EX3-3503 Mar24)	Mar-25
DAE4	SN: 601	30-Jan-24 (No. DAE4-601_Jan24)	Jan-25
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24
	Name	Function	Signature
Calibrated by:	Paulo Pina	Laboratory Technician	Tomber
Approved by:	Sven Kühn	Technical Manager	

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



Schweizerischer Kalibrierdienst

C Service suisse d'étalonnage Servizio svizzero di taratura

S Swiss Calibration Service

Swiss Calibration Service

Accreditation No.: SCS 0108

Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



Schweizerischer Kalibrierdienst

Service suisse d'étalonnage

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Servizio svizzero di taratura

Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Glossary:

TSL	tissue simulating liquid	
ConvF	sensitivity in TSL / NORM x,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-Worn 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) DASY 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss: This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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%.

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz 5850 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

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	36.7 ± 6 %	4.58 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.84 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.7 W/kg ± 19.9 % (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 ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

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	36.1 ± 6 %	4.97 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.8 W/kg ± 19.9 % (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	23.5 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5750 MHz

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	35.8 ± 6 %	5.14 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.85 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.4 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5850 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.2	5.32 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.8 ± 6 %	5.24 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5850 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.0 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	49.2 Ω - 3.5 jΩ	
Return Loss	- 28.8 dB	

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	55.0 Ω - 0.3 jΩ	
Return Loss	- 26.4 dB	

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	54.8 Ω - 0.7 jΩ	
Return Loss	- 26.7 dB	

Antenna Parameters with Head TSL at 5850 MHz

Impedance, transformed to feed point	56.3 Ω - 3.9 jΩ
Return Loss	- 23.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.198 ns	
	1.10	10 115

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

DASY5 Validation Report for Head TSL

Date: 25.04.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1160

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5850 MHz Medium parameters used: f = 5250 MHz; $\sigma = 4.58$ S/m; $\varepsilon_r = 36.7$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5600 MHz; $\sigma = 4.97$ S/m; $\varepsilon_r = 36.1$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5750 MHz; $\sigma = 5.14$ S/m; $\varepsilon_r = 35.8$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5850 MHz; $\sigma = 5.24$ S/m; $\varepsilon_r = 35.8$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5850 MHz; $\sigma = 5.24$ S/m; $\varepsilon_r = 35.8$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5850 MHz; $\sigma = 5.24$ S/m; $\varepsilon_r = 35.8$; $\rho = 1000$ kg/m³

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.39, 5.39, 5.39) @ 5250 MHz, ConvF(5, 5, 5) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz, ConvF(4.89, 4.89, 4.89) @ 5850 MHz; Calibrated: 07.03.2024
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 72.71 V/m; Power Drift = 0.05 dB Peak SAR (extrapolated) = 26.2 W/kg SAR(1 g) = 7.84 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 = 71.3% Maximum value of SAR (measured) = 17.5 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 72.07 V/m; Power Drift = 0.05 dB Peak SAR (extrapolated) = 29.5 W/kg SAR(1 g) = 8.16 W/kg; SAR(10 g) = 2.34 W/kg Smallest distance from peaks to all points 3 dB below = 7.4 mm Ratio of SAR at M2 to SAR at M1 = 68.7% Maximum value of SAR (measured) = 18.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 69.69 V/m; Power Drift = 0.07 dB Peak SAR (extrapolated) = 30.0 W/kg SAR(1 g) = 7.85 W/kg; SAR(10 g) = 2.23 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 67% Maximum value of SAR (measured) = 18.6 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5850 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 69.55 V/m; Power Drift = 0.05 dB Peak SAR (extrapolated) = 31.4 W/kg SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.29 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 66% Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg

Impedance Measurement Plot for Head TSL

