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

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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	
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) °C	38.7 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**39.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.7 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	52.1 Ω + 4.3 jΩ
Return Loss	- 26.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 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: 26.07.2022

Test Laboratory: SPEAG, Zurich, Switzerland

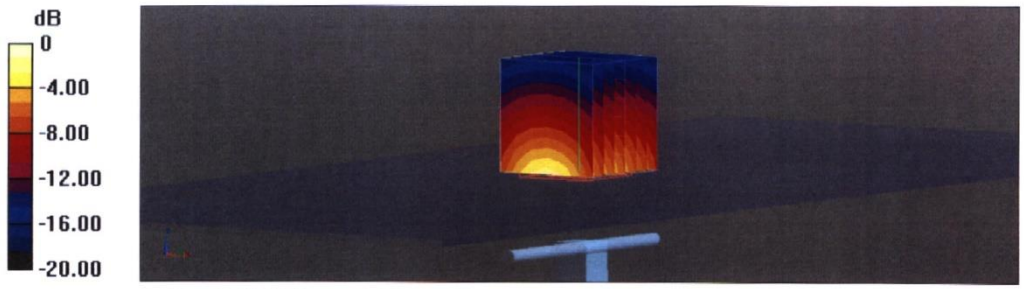
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d101

Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 S/m; ε_r = 38.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

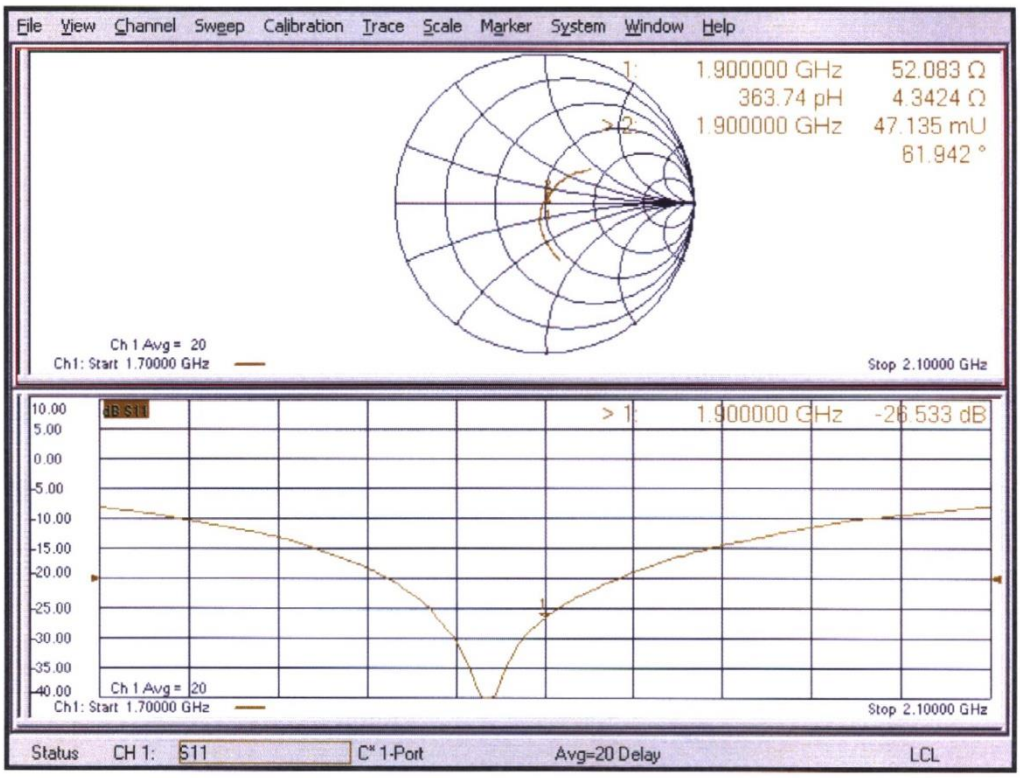
- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43) @ 1900 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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 = 109.0 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 18.5 W/kg
SAR(1 g) = 9.90 W/kg; SAR(10 g) = 5.18 W/kg
Smallest distance from peaks to all points 3 dB below = 10 mm
Ratio of SAR at M2 to SAR at M1 = 54.1%
Maximum value of SAR (measured) = 15.5 W/kg



0 dB = 15.5 W/kg = 11.90 dBW/kg

Impedance Measurement Plot for Head TSL



2450 MHz Dipole Calibration Certificate

Calibration Laboratory of
Schmid & Partner
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Accreditation No.: SCS 0108

Client **CTTL (Auden)** Certificate No: **D2450V2-853_Jul22**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN:853
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	July 20, 2022

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 NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: BH9394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23
Type-N mismatch combination	SN: 310982 / 06327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22
DAE4	SN: 601	02-May-22 (No. DAE4-601_May22)	May-23

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

	Name	Function	Signature
Calibrated by:	Aidonia Georgiadou	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: July 22, 2022

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:

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	37.9 ± 6 %	1.85 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.9 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	54.3 Ω + 4.7 jΩ
Return Loss	- 24.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.162 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: 20.07.2022

Test Laboratory: SPEAG, Zurich, Switzerland

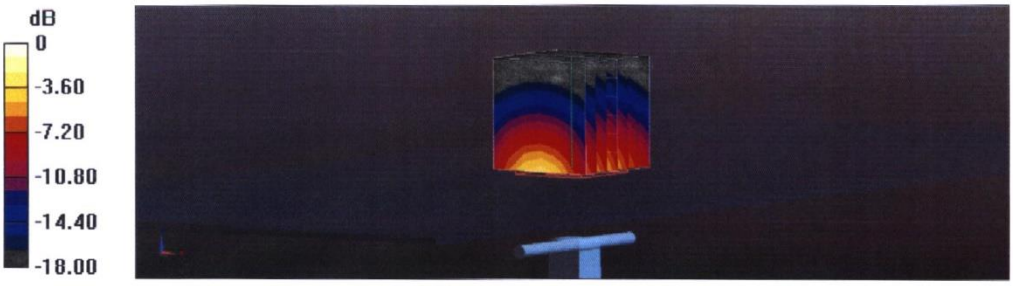
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:853

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.85 S/m; ε_r = 37.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

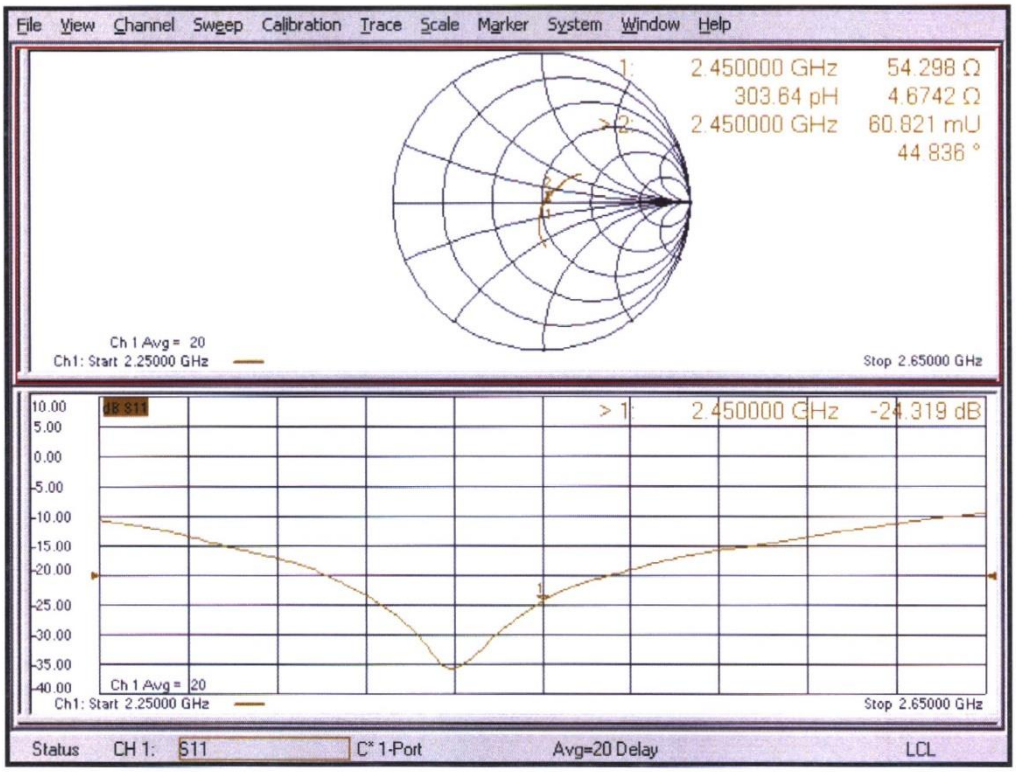
- Probe: EX3DV4 - SN7349; ConvF(7.96, 7.96, 7.96) @ 2450 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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 = 116.2 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 26.6 W/kg
SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.29 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 50.6%
Maximum value of SAR (measured) = 22.2 W/kg



0 dB = 22.2 W/kg = 13.47 dBW/kg

Impedance Measurement Plot for Head TSL



2600 MHz Dipole Calibration Certificate

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

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Accreditation No.: SCS 0108

Client CTTL (Auden) **Certificate No: D2600V2-1012_Jul22**

CALIBRATION CERTIFICATE

Object	D2600V2 - SN:1012
Calibration procedure(s)	QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz
Calibration date:	July 20, 2022

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 NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: BH9394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23
Type-N mismatch combination	SN: 310982 / 06327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22
DAE4	SN: 601	02-May-22 (No. DAE4-601_May22)	May-23

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

	Name	Function	Signature
Calibrated by:	Aidonia Georgiadou	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: July 22, 2022

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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:

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	37.3 ± 6 %	2.01 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**55.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.2 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	46.7 Ω - 6.4 jΩ
Return Loss	- 22.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.151 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: 20.07.2022

Test Laboratory: SPEAG, Zurich, Switzerland

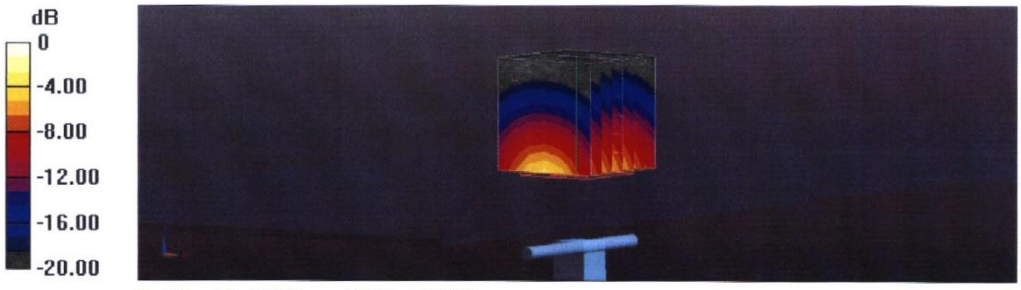
DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1012

Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; σ = 2.01 S/m; ε_r = 37.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

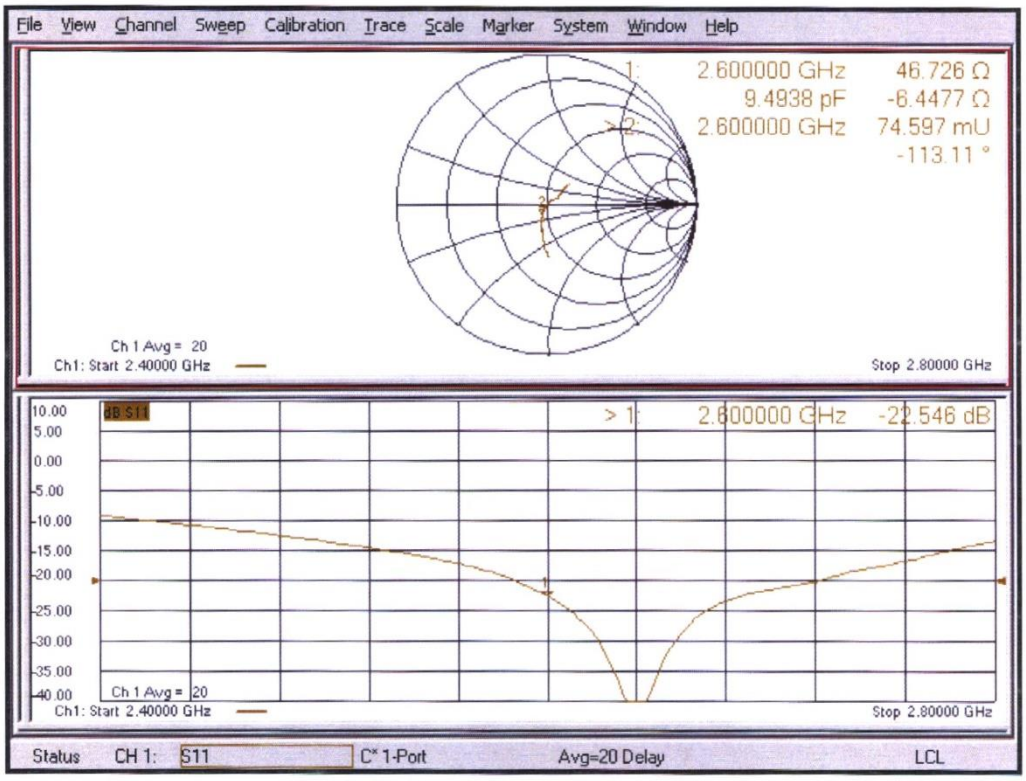
- Probe: EX3DV4 - SN7349; ConvF(7.84, 7.84, 7.84) @ 2600 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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 = 116.6 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 28.1 W/kg
SAR(1 g) = 14.2 W/kg; SAR(10 g) = 6.38 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 50.4%
Maximum value of SAR (measured) = 23.6 W/kg



0 dB = 23.6 W/kg = 13.73 dBW/kg

Impedance Measurement Plot for Head TSL



ANNEX I SPOT CHECK

I.1 Dielectric Performance and System Validation

Table I.1-1: Dielectric Performance of Tissue Simulating Liquid

Measurement Date (yyyy-mm-dd)	Type	Frequency	Permittivity ε	Drift (%)	Conductivity σ (S/m)	Drift (%)
2023-2-3	Head	835MHz	43.07	3.78	0.925	2.78
2023-2-5	Head	1900MHz	41.01	2.53	1.449	3.50

Table I.1-2: System Validation of Head

Measurement Date (yyyy-mm-dd)	Frequency	Target value (W/kg)		Measured value(W/kg)		Deviation	
		10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average
2023-2-3	835MHz	6.34	9.73	6.24	9.44	-1.58%	-2.98%
2023-2-5	1900MHz	20.7	39.7	21.1	40.4	1.84%	1.76%

I.2 Measurement result

RF Exposure Conditions	Frequency Band	Channel Number	Frequency (MHz)	Mode/RB	Test Position	Distance	Figure No./Note	EUT Measured Power (dBm)	Tune up (dBm)	Measured SAR 1g (W/kg)	Reported SAR 1g (W/kg)	Measured SAR 10g (W/kg)	Reported SAR 10g (W/kg)	Power Drift
Body	WCDMA1900	9262	1852.4	RMC	Rear	10mm	F.8	21.33	21.5	0.918	**0.95**	0.489	**0.51**	0.07
Head	LTE Band26	26965	841.5	1RB-Mid	Cheek Right	0mm	F.28	22.82	23.5	0.823	**0.96**	0.429	**0.50**	-0.06

I.3 Reported SAR Comparison

Table I.3: Highest Reported SAR (1g)

Mode		1g SAR Head original	1g SAR Hotspot original	1g SAR Body-worn original	1g SAR Head spot check	1g SAR Hotspot spot check
GSM	GSM850	0.11	0.31	0.11	/	/
	GSM1900	0.08	0.74	0.37	/	/
WCDMA	UMTS FDD 5	0.95	0.98	0.49	/	/
	UMTS FDD 4	0.28	1.00	0.64	/	/
	UMTS FDD 2	0.21	1.09	0.54	/	/
LTE	LTE Band 2	0.19	0.82	0.57	/	/
	LTE Band 7	0.12	1.09	0.75	/	0.95
	LTE Band 12	0.39	0.13	0.15	/	/
	LTE Band 13	0.62	0.27	0.19	/	/
	LTE Band 26	1.05	0.54	0.29	0.96	/
	LTE Band 38	0.03	0.97	0.49	/	/
	LTE Band 66	0.22	0.86	0.60	/	/
WLAN 2.4 GHz		0.67	0.19	0.19		/
BT		0.01	<0.01	<0.01		/

Note: All the spot check results are less than the original result. So it shares all the original results.

I.4 Main Test Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	N5239A	MY55491241	June 2, 2022	One year
02	Power sensor	NRP8S	104291	September 22, 2022	One year
03	Power sensor	NRP8S	104292		
04	Signal Generator	E4438C	MY49070393	May 17, 2022	One Year
05	Amplifier	60S1G4	0331848	No Calibration Requested	
06	BTS	CMW500	129942	February 14 2022	One year
07	DAE	SPEAG DAE4	777	January 11, 2023	One year
08	E-field Probe	SPEAG EX3DV4	7673	July 08，2022	One year
09	Dipole Validation Kit	SPEAG D835V2	4d069	July 20,2022	One year
10	Dipole Validation Kit	SPEAG D1900V2	5d101	July 26,2022	One year

I.5 Graph Results

WCDMA1900 Body

Date/Time: 2/3/2023

Electronics: DAE4 Sn777

Medium: H700-6000M

Medium parameters used (interpolated): f = 1852.4 MHz; σ = 1.42 S/m; εr = 41.06; ρ = 1000 kg/m3

Ambient Temperature:23.3oC Liquid Temperature: 22.5oC

Communication System: UID 0, WCDMA 1900 (0) Frequency: 1852.4 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7673 ConvF(8.07, 8.07, 8.07)

Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.34 W/kg

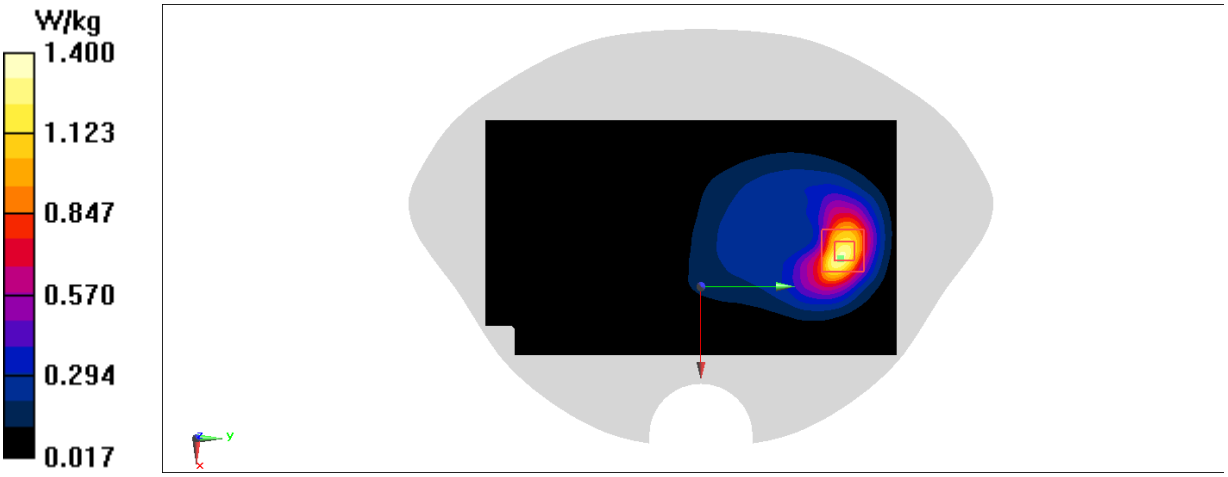
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.894 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 1.67 W/kg

SAR(1 g) = 0.918 W/kg; SAR(10 g) = 0.489 W/kg

Maximum value of SAR (measured) = 1.40 W/kg



LTE B26 Head

Date/Time: 2/5/2023

Electronics: DAE4 Sn777

Medium: H700-6000M

Medium parameters used (interpolated): f = 841.5 MHz; σ = 0.927 S/m; εr = 43.054; ρ = 1000 kg/m3

Ambient Temperature:23.3oC Liquid Temperature: 22.5oC

Communication System: UID 0, LTE Band26 (0) Frequency: 841.5 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7673 ConvF(10.34, 10.34, 10.34)

Area Scan (81x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.61 W/kg

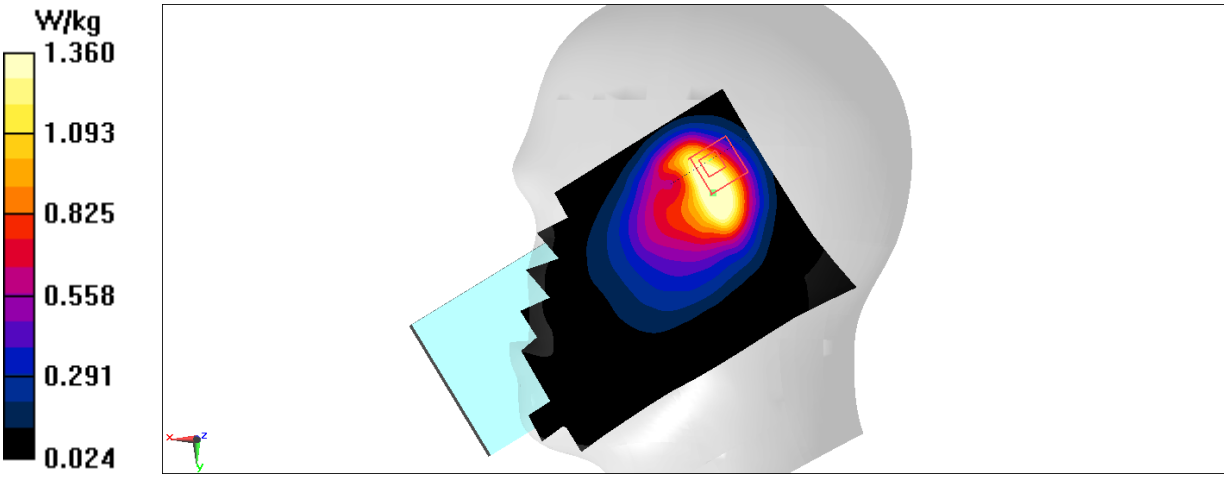
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 35.43 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 1.85 W/kg

SAR(1 g) = 0.823 W/kg; SAR(10 g) = 0.429 W/kg

Maximum value of SAR (measured) = 1.36 W/kg



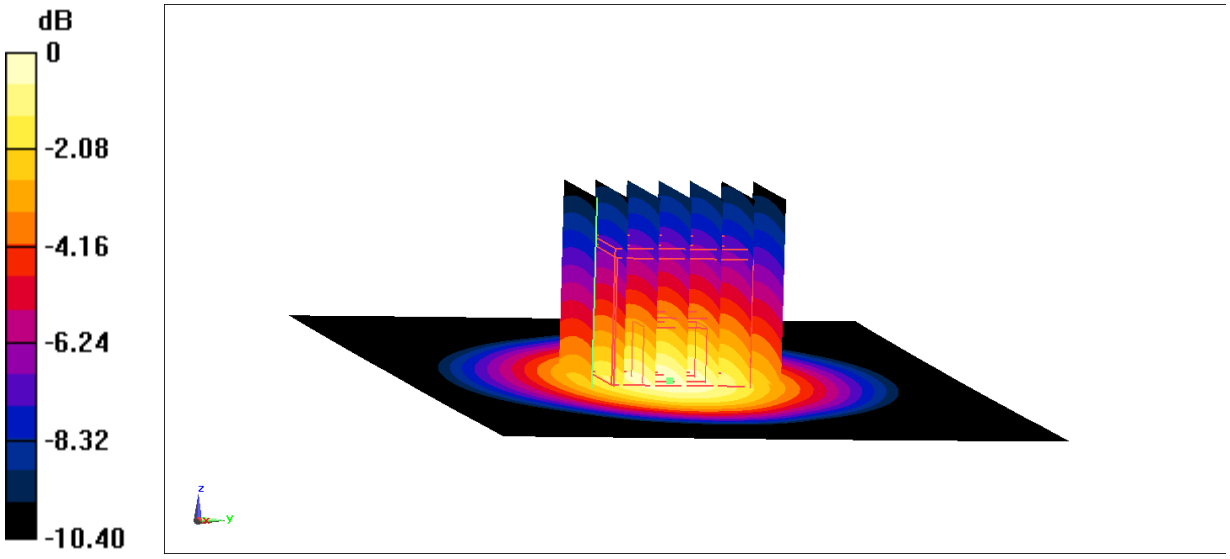
I.6 System Validation Results

835 MHz

Date: 2/3/2023
Electronics: DAE4 Sn777
Medium: H700-6000M
Medium parameters used: f = 835 MHz; σ = 0.925 S/m; ε r = 43.07; ρ = 1000 kg/m3
Ambient Temperature:23.3℃ Liquid Temperature: 22.5℃
Communication System: CW (0) Frequency: 835 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN7673 ConvF(10.34, 10.34, 10.34)

Area Scan (131x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 3.12 W/kg

Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.07 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 3.623 W/kg
SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.56 W/kg
Maximum value of SAR (measured) = 3.19 W/kg



0 dB = 3.19 W/kg = 5.04 dBW/kg

1900 MHz

Date: 2/5/2023

Electronics: DAE4 Sn777

Medium: H700-6000M

Medium parameters used: f = 1900 MHz; σ = 1.449 S/m; ε_r = 41.01; ρ = 1000 kg/m3

Ambient Temperature:23.3℃ Liquid Temperature: 22.5℃

Communication System: CW (0) Frequency: 1900 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7673 ConvF(8.07, 8.07, 8.07)

Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 16.5 W/kg

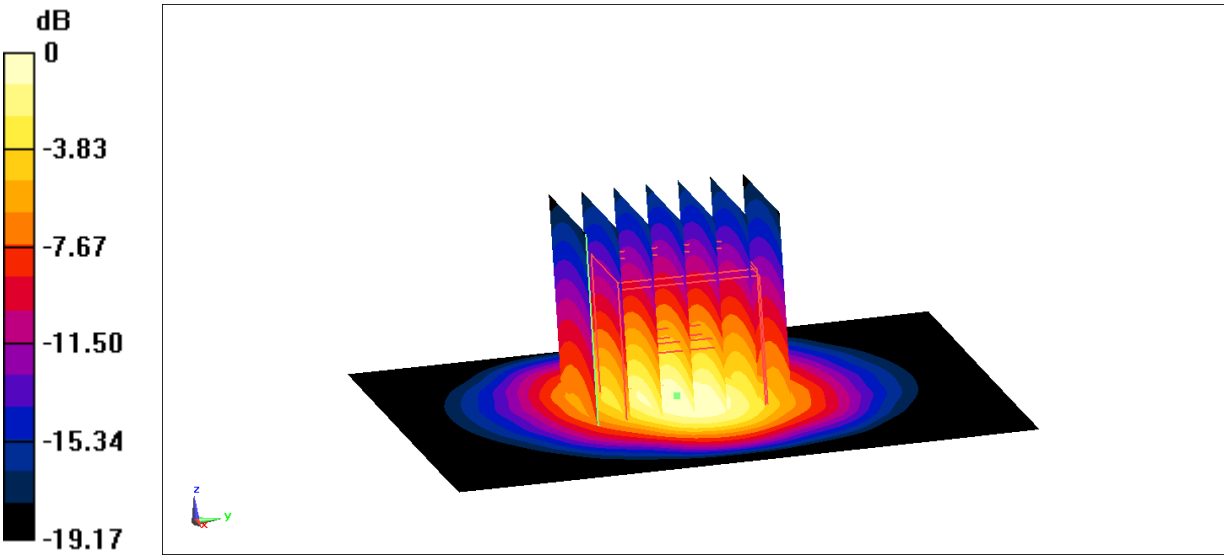
Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.1 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 19.8 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.27 W/kg

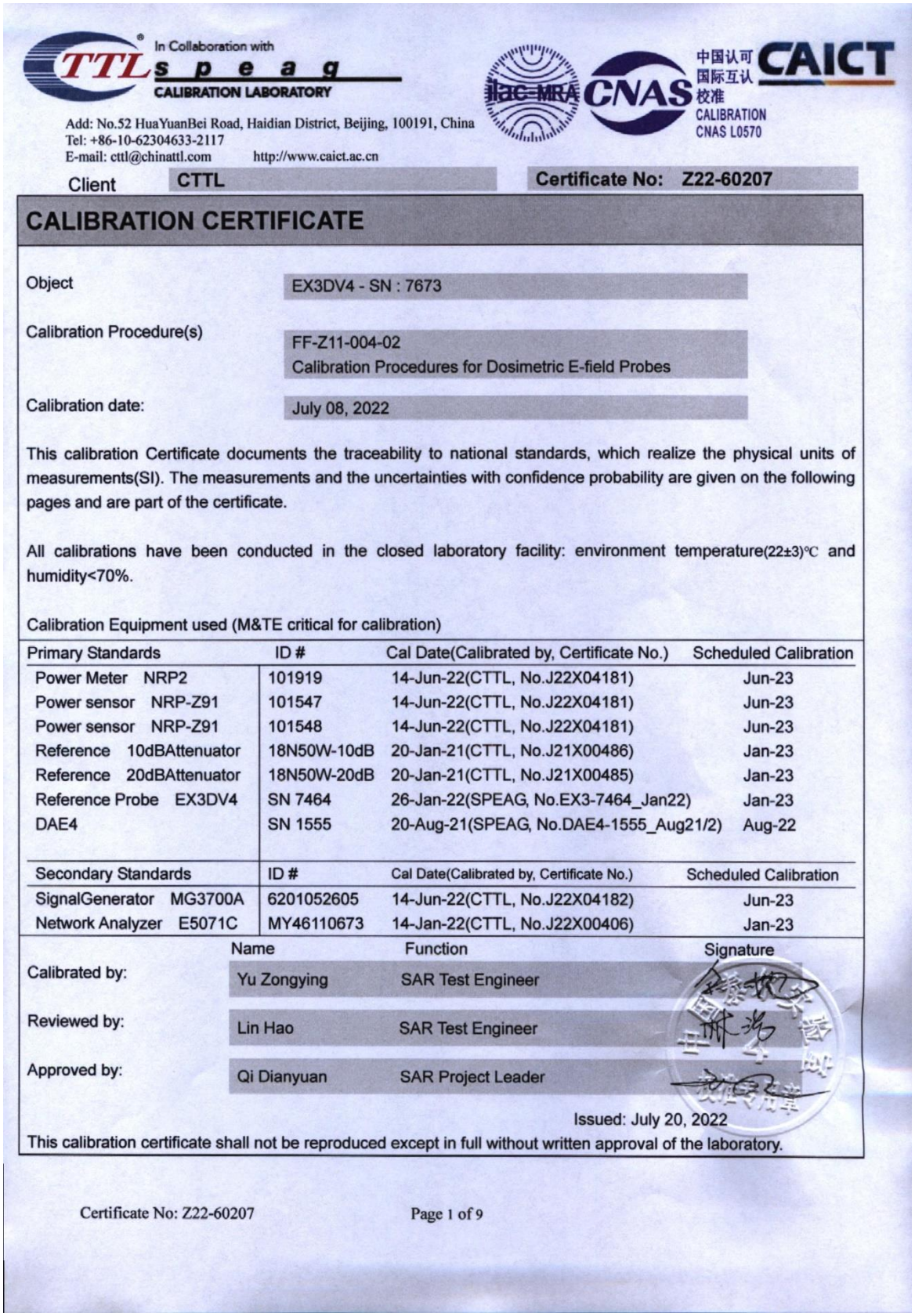
Maximum value of SAR (measured) = 16.1 W/kg



0 dB = 16.1 W/kg = 12.07 dBW/kg

I.7 Probe Calibration Certificate

Probe 7673 Calibration Certificate



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中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client CTTL Certificate No: Z22-60207

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN : 7673
Calibration Procedure(s)	FF-Z11-004-02 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	July 08, 2022

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	101919	14-Jun-22(CTTL, No.J22X04181)	Jun-23
Power sensor NRP-Z91	101547	14-Jun-22(CTTL, No.J22X04181)	Jun-23
Power sensor NRP-Z91	101548	14-Jun-22(CTTL, No.J22X04181)	Jun-23
Reference 10dBAttenuator	18N50W-10dB	20-Jan-21(CTTL, No.J21X00486)	Jan-23
Reference 20dBAttenuator	18N50W-20dB	20-Jan-21(CTTL, No.J21X00485)	Jan-23
Reference Probe EX3DV4	SN 7464	26-Jan-22(SPEAG, No.EX3-7464_Jan22)	Jan-23
DAE4	SN 1555	20-Aug-21(SPEAG, No.DAE4-1555_Aug21/2)	Aug-22

Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGenerator MG3700A	6201052605	14-Jun-22(CTTL, No.J22X04182)	Jun-23
Network Analyzer E5071C	MY46110673	14-Jan-22(CTTL, No.J22X00406)	Jan-23

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: July 20, 2022

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

Certificate No: Z22-60207 Page 1 of 9

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Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A,B,C,D	modulation dependent linearization parameters
Polarization Φ	Φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i θ=0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

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 the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016

c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below ConvF).
- *NORM(f)x,y,z = NORMx,y,z* frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- *Ax,y,z; Bx,y,z; Cx,y,z; VRx,y,z:* A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from±50MHz to±100MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7673

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (*k*=2)
Norm(μV/(V/m)²)[A]	0.62	0.63	0.61	±10.0%
DCP(mV)[B]	110.3	111.1	110.2	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (*k*=2)
0	CW	X	0.0	0.0	1.0	0.00	198.1	±2.1%
		Y	0.0	0.0	1.0		199.1	
		Z	0.0	0.0	1.0		193.0	

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%.

[A] The uncertainties of Norm X, Y, Z do not affect the E²-field uncertainty inside TSL (see Page 4).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7673

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	41.9	0.89	10.34	10.34	10.34	0.14	1.40	±12.1%
900	41.5	0.97	9.95	9.95	9.95	0.17	1.30	±12.1%
1750	40.1	1.37	8.49	8.49	8.49	0.26	0.98	±12.1%
1900	40.0	1.40	8.07	8.07	8.07	0.24	1.07	±12.1%
2000	40.0	1.40	8.08	8.08	8.08	0.20	1.31	±12.1%
2300	39.5	1.67	7.86	7.86	7.86	0.62	0.66	±12.1%
2450	39.2	1.80	7.57	7.57	7.57	0.60	0.68	±12.1%
2600	39.0	1.96	7.31	7.31	7.31	0.65	0.65	±12.1%
3300	38.2	2.71	6.93	6.93	6.93	0.36	0.99	±13.3%
3500	37.9	2.91	6.73	6.73	6.73	0.40	0.94	±13.3%
3700	37.7	3.12	6.50	6.50	6.50	0.30	1.20	±13.3%
3900	37.5	3.32	6.44	6.44	6.44	0.30	1.50	±13.3%
4100	37.2	3.53	6.46	6.46	6.46	0.30	1.40	±13.3%
4200	37.1	3.63	6.35	6.35	6.35	0.35	1.35	±13.3%
4400	36.9	3.84	6.26	6.26	6.26	0.30	1.50	±13.3%
4600	36.7	4.04	6.10	6.10	6.10	0.35	1.50	±13.3%
4800	36.4	4.25	5.99	5.99	5.99	0.35	1.60	±13.3%
4950	36.3	4.40	5.65	5.65	5.65	0.35	1.65	±13.3%
5250	35.9	4.71	5.21	5.21	5.21	0.40	1.42	±13.3%
5600	35.5	5.07	4.71	4.71	4.71	0.40	1.50	±13.3%
5750	35.4	5.22	4.70	4.70	4.70	0.40	1.50	±13.3%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

