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Client UL Korea (Dymstec)

OAL

Certificate No: CLA13-1015_Oct21

Accreditation No.: SCS 0108

Object	CLA13 - SN: 10	15	
Calibration procedure(s)	QA CAL-15.v9 Calibration Proc	edure for SAR Validation Source	s below 700 MHz
Calibration date:	October 12, 202	1	
The measurements and the uncer	tainties with confidence p	tional standards, which realize the physical un probability are given on the following pages a pry facility: environment temperature (22 ± 3)°	nd are part of the certificate.
	Line		
Primary Standards	ID #	Cal Date (Certificate No.)	Schodulad Calibratian
ower meter NRP	ID # SN: 104778	Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292)	Scheduled Calibration
ower meter NRP		09-Apr-21 (No. 217-03291/03292)	Apr-22
ower meter NRP ower sensor NRP-Z91	SN: 104778	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291)	Apr-22 Apr-22
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator	SN: 104778 SN: 103244	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292)	Apr-22 Apr-22 Apr-22
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination	SN: 104778 SN: 103244 SN: 103245	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343)	Apr-22 Apr-22 Apr-22 Apr-22
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination eference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x)	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 AE4	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344)	Apr-22 Apr-22 Apr-22 Apr-22
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator ype-N mismatch combination Reference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-3877_Dec20) 28-Jun-21 (No. DAE4-654_Jun21)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Jun-22
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination eference Probe EX3DV4 AE4 econdary Standards	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-3877_Dec20) 28-Jun-21 (No. DAE4-654_Jun21) Check Date (in house)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Jun-22 Scheduled Check
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination eference Probe EX3DV4 AE4 econdary Standards ower meter E4419B ower sensor E4412A	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-3877_Dec20) 28-Jun-21 (No. DAE4-654_Jun21) Check Date (in house) 06-Apr-16 (in house check Jun-20)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Jun-22 Scheduled Check In house check: Jun-22
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ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination eference Probe EX3DV4 AE4 econdary Standards ower meter E4419B ower sensor E4412A ower sensor E4412A F generator HP 8648C	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654 ID # SN: GB41293874 SN: MY41498087	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-3877_Dec20) 28-Jun-21 (No. DAE4-654_Jun21) Check Date (in house) 06-Apr-16 (in house check Jun-20)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Jun-22 Scheduled Check In house check: Jun-22 In house check: Jun-22 In house check: Jun-22
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Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator ype-N mismatch combination reference Probe EX3DV4 AE4	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 654 ID # SN: GB41293874 SN: MY41498087 SN: 000110210 SN: US3642U01700 SN: US41080477 Name	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 30-Dec-20 (No. EX3-3877_Dec20) 28-Jun-21 (No. DAE4-654_Jun21) Check Date (in house) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 06-Apr-16 (in house check Jun-20) 04-Aug-99 (in house check Jun-20) 31-Mar-14 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Jun-22 Scheduled Check In house check: Jun-22 In house check: Oct-22





- S Schweizerischer Kalibrierdienst
- Service suisse d'étalonnage C
- Servizio svizzero di taratura
- S Swiss Calibration Service

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Accreditation No.: SCS 0108

Glossary:	
TSL	
ConvF	
NIA	

SL onvF ⁄A	tissue simulating liquid sensitivity in TSL / NORM x,y,z
~	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
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the

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

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
EUT Positioning	Touch Position	
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	13 MHz ± 1 MHz	

Head TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	55.0	0.75 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	53.3 ± 6 %	0.73 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	1 W input power	0.535 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	0.543 W/kg ± 18.4 % (k=2)

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	1 W input power	0.332 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	0.337 W/kg ± 18.0 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.7 Ω + 3.5 jΩ
Return Loss	- 28.4 dB

Additional EUT Data

Monufacture disc	
Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 12.10.2021

Test Laboratory: SPEAG, Zurich, Switzerland

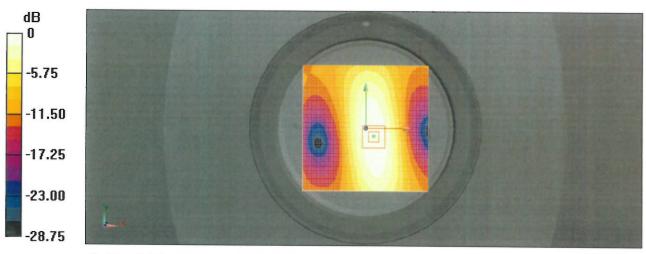
DUT: CLA13; Type: CLA13; Serial: CLA13 - SN: 1015

Communication System: UID 0 - CW; Frequency: 13 MHz Medium parameters used: f = 13 MHz; σ = 0.73 S/m; ϵ_r = 53.3; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 SN3877; ConvF(15.33, 15.33, 15.33) @ 13 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 28.06.2021
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

CLA Calibration for HSL-LF Tissue/CLA-13, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 28.62 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 1.09 W/kg SAR(1 g) = 0.535 W/kg; SAR(10 g) = 0.332 W/kg Smallest distance from peaks to all points 3 dB below: Larger than measurement grid (> 30 mm) Ratio of SAR at M2 to SAR at M1 = 78.2% Maximum value of SAR (measured) = 0.787 W/kg



0 dB = 0.787 W/kg = -1.04 dBW/kg

Impedance Measurement Plot for Head TSL

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Accreditation No.: SCS 0108

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Client UL Korea (Dymstec)

Certificate No: D750V3-1205_Apr21

CALIBRATION CERTIFICATE

	_		
Object	D750V3 - SN:12	05	
Calibration procedure(s)	QA CAL-05.v11		
	Calibration Proce	edure for SAR Validation Source	s between 0.7-3 GHz
Calibration date:	April 27, 2021		
This calibration certificate docume	nts the traceability to nat	ional standards, which realize the physical u	inite of measurements (SI)
The measurements and the uncert	tainties with confidence p	robability are given on the following pages a	and are part of the certificate
		, are given on the following pages a	and are part of the certilicate.
All calibrations have been conduct	ed in the closed laborator	ry facility: environment temperature (22 ± 3)	°O and humidity Tool
		y racinty, environment temperature $(22 \pm 3)^{\circ}$	\sim and humidity < 70%.
Calibration Equipment used (M&TE	E oritical for calibration)		
cansiation Equipment used (Mart	- childer for calibration)		
Primary Standards	ID #	Cal Data (Cortificate No.)	
Power meter NBP	SN: 104778	Cal Date (Certificate No.)	Scheduled Calibration
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03291)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03292)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 7349	and a set of the set o	Apr-22
DAE4	SN: 601	28-Dec-20 (No. EX3-7349_Dec20)	Dec-21
		02-Nov-20 (No. DAE4-601_Nov20)	Nov-21
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: MY41092317	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
		,	in house check. Out-21
	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	1 , 1
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Approved by:	Katja Pokovic	Technical Manager	d. fitu
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This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Calibration Laboratory of

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





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- C Service suisse d'étalonnage
- Servizio svizzero di taratura
- S Swiss Calibration Service

Accreditation No.: SCS 0108

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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) 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"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed
 point exactly below the center marking of the flat phantom section, with the arms oriented
 parallel to the body axis.
- Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	·····
Frequency	750 MHz ± 1 MHz	

Head TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.2 ± 6 %	0.90 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	2.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.66 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	· · · · · · · · · · · · · · · · · · ·
SAR averaged over 10 cm ³ (10 g) of Head TSL.	condition 250 mW input power	1.42 W/kg

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.8 Ω - 0.8 jΩ
Return Loss	- 28.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	
	1.038 ns
,	1.000113

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	CDEAO
indiaduou by	SPEAG

DASY5 Validation Report for Head TSL

Date: 27.04.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1205

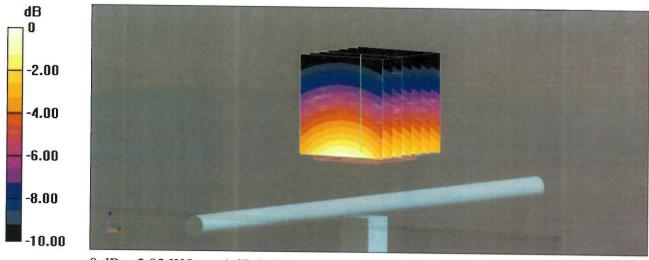
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; σ = 0.9 S/m; ϵ_r = 42.2; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.11, 10.11, 10.11) @ 750 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

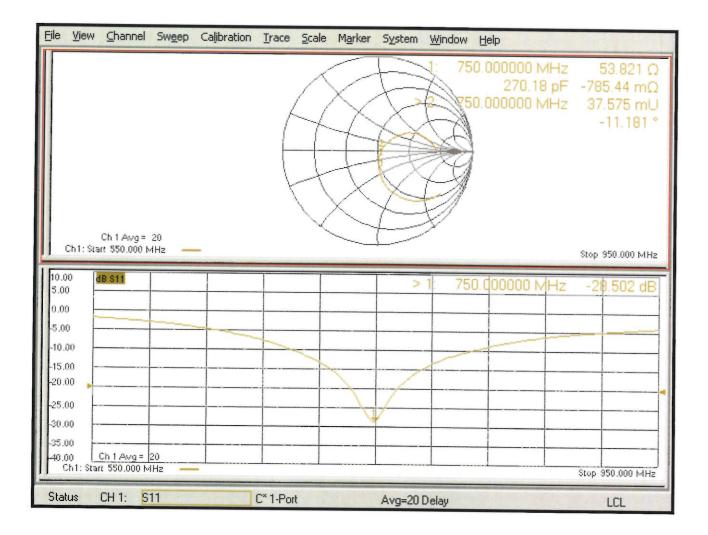
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 60.00 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 3.30 W/kg SAR(1 g) = 2.18 W/kg; SAR(10 g) = 1.42 W/kg Smallest distance from peaks to all points 3 dB below = 21.9 mm Ratio of SAR at M2 to SAR at M1 = 65.9% Maximum value of SAR (measured) = 2.93 W/kg



0 dB = 2.93 W/kg = 4.67 dBW/kg

Impedance Measurement Plot for Head TSL



Justification for Extended SAR Dipole Calibrations

Instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the SAR target, impedance and return loss of a dipole have remain stable according to the following requirements

KDB 865664 D01v01r04 requirements

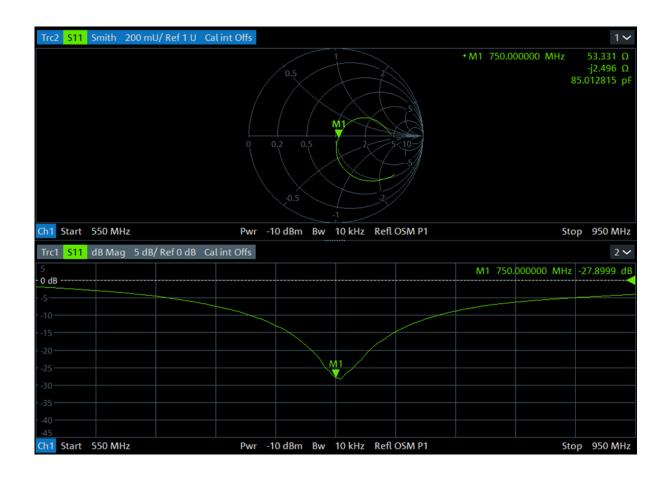
a) return loss : < - 20 dB, within 20% of previous measurement

b) impedance : within 5 $\boldsymbol{\Omega}$ from previous measurement

Dipole Antenna	Head/Body	Date of Measurement	Return Loss (dB)	Δ%	Impedance (Ω)	ΔΩ
D750V3-SN : 1205	Head	2021.04.27	-28.5	ſ	53.8	1
D750V5-5N . 1205	пеай	2022.04.19	-27.9	-2	53.3	-1

c) extrapolated peak SAR : within 10% of that reported in the calibration data

Dipole Antenna	Head/Body	Date of Measurement	extrapolated peak SAR (W/kg)	Δ%
D7E0V/2 CN - 120E	Llood	2021.04.27	8.66	n
D750V3-SN : 1205 Head		2022.04.04	8.5	-2





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Client UL Korea (Dymstec)

Certificate No: D835V2-4d174_Mar21

Accreditation No.: SCS 0108

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CALIBRATION CERTIFICATE

Object	D835V2 - SN:40	1174	
Calibration procedure(s)	QA CAL-05.v11		
		edure for SAR Validation Source	s between 0.7-3 GHz
Calibration date:	March 17, 2021		
This calibration certificate docume	nts the traceability to not		
The measurements and the uncert	tainties with confidence p	ional standards, which realize the physical ur probability are given on the following pages a	nits of measurements (SI). Ind are part of the certificate.
	ed in the closed laborato	ry facility: environment temperature $(22 \pm 3)^{\circ}$	C and humidity < 70%.
Calibration Equipment used (M&TE	E critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
ype-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	28-Dec-20 (No. EX3-7349_Dec20)	Dec-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21
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: MY41092317	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-21
	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	e-1411
			alffin
Approved by:	Katja Pokovic	Technical Manager	alles





S

Schweizerischer Kalibrierdienst

C Service suisse d'étalonnage

Servizio svizzero di taratura

S Swiss Calibration Service

Accreditation No.: SCS 0108

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

Glossary:

elecculy.	
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) 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"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	<u></u>

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.0 ± 6 %	0.93 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	2.48 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.70 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 250 mW input power	1.60 W/kg

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7 Ω - 3.5 jΩ
Return Loss	- 28.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.007
	1.397 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
	ST LAB

DASY5 Validation Report for Head TSL

Date: 17.03.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d174

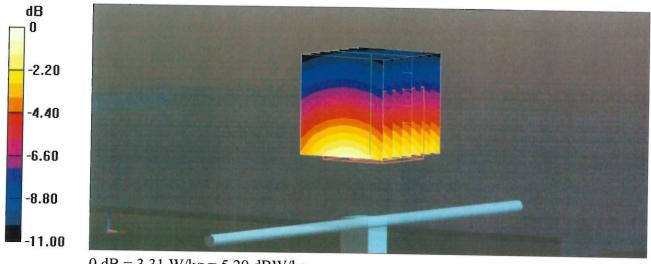
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 0.93$ S/m; $\varepsilon_r = 42$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.69, 9.69, 9.69) @ 835 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

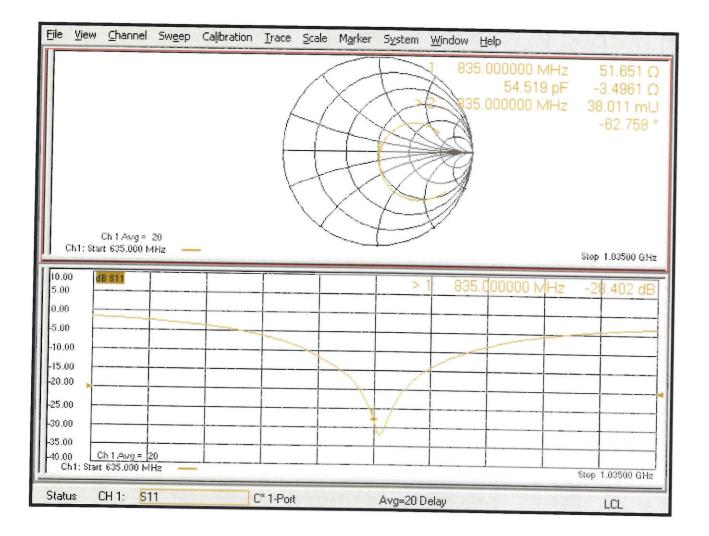
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 63.09 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 3.74 W/kg **SAR(1 g) = 2.48 W/kg; SAR(10 g) = 1.6 W/kg** Smallest distance from peaks to all points 3 dB below = 15.5 mm Ratio of SAR at M2 to SAR at M1 = 66% Maximum value of SAR (measured) = 3.31 W/kg



0 dB = 3.31 W/kg = 5.20 dBW/kg

Impedance Measurement Plot for Head TSL



Justification for Extended SAR Dipole Calibrations

Instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the SAR target, impedance and return loss of a dipole have remain stable according to the following requirements

KDB 865664 D01v01r04 requirements

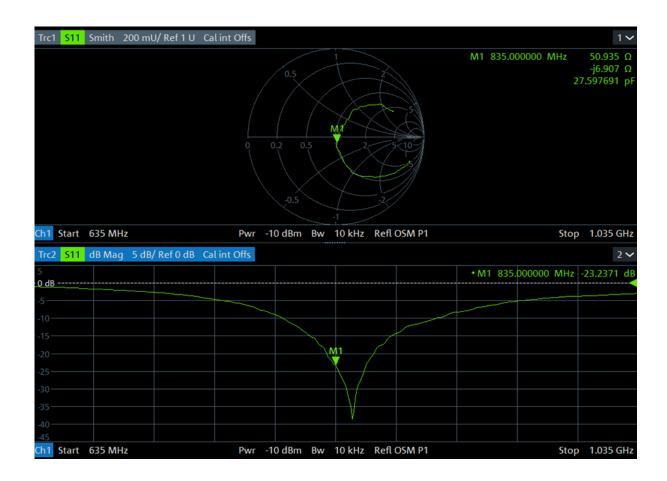
a) return loss : < - 20 dB, within 20% of previous measurement

b) impedance : within 5 $\boldsymbol{\Omega}$ from previous measurement

Dipole Antenna	Head/Body	Date of Measurement	Return Loss (dB)	Δ%	Impedance (Ω)	ΔΩ
D835V2-SN : 4d174	Head	2021.03.17	-28.4	-18	51.7	r
D855V2-5N . 40174	пеай	2022.03.14	-23.2	-10	50.9	-2

c) extrapolated peak SAR : within 10% of that reported in the calibration data

Dipole Antenna	Head/Body	Date of Measurement	extrapolated peak SAR (W/kg)	Δ%
	2021.03.17	9.7	1	
D835V2-SN : 4d174	Head	2022.03.14	9.6	-1







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Client UL Korea (Dymstec)

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Certificate No: D835V2-4d194_Mar22

Accreditation No.: SCS 0108

Object	D835V2 - SN:40	1194	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proc	edure for SAR Validation Source	s between 0.7-3 GHz
Calibration date:	March 24, 2022		
The measurements and the uncer	tainties with confidence p ted in the closed laborato	ional standards, which realize the physical ur probability are given on the following pages a ry facility: environment temperature (22 ± 3)°	nd are part of the certificate.
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22 Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22 Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22
Reference Probe EX3DV4			
Reference Probe EX3DV4 DAE4	SN: 601	01-Nov-21 (No. DAE4-601_Nov21)	Nov-22
	SN: 601 ID #		
DAE4	, Tanan	Check Date (in house)	Scheduled Check
DAE4 Secondary Standards	ID #	Check Date (in house) 30-Oct-14 (in house check Oct-20)	Scheduled Check In house check: Oct-22
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A	ID # SN: GB39512475	Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Scheduled Check In house check: Oct-22 In house check: Oct-22
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	ID # SN: GB39512475 SN: US37292783	Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A	ID # SN: GB39512475 SN: US37292783 SN: MY41093315	Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Scheduled Check In house check: Oct-22 In house check: Oct-22
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972	Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20)	Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477 Name	Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20) Function	Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477	Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20)	Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477 Name	Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20) Function	Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477 Name Aidonia Georgiadou	Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20) Function Laboratory Technician	Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22

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Accreditation No.: SCS 0108

TSL ConvF N/A	tissue simulating liquid sensitivity in TSL / NORM x,y,z not applicable or not measured
1 1/7 1	not applicable of 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	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	· · · · · · · · · · · · · · · · · · ·
Frequency	835 MHz ± 1 MHz	9999-1-1

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41,5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.8 ± 6 %	0.92 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	2.48 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.77 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.62 W/kg

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.2 Ω - 3.4 jΩ
Return Loss	- 29.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction) 1.393 ns	
1.393 IIS	

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

NA	
Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 24.03.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d194

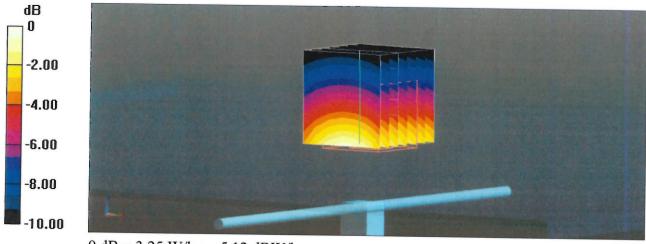
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; σ = 0.92 S/m; ϵ_r = 41.8; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.69, 9.69, 9.69) @ 835 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 01.11.2021
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 63.87 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 3.68 W/kg SAR(1 g) = 2.48 W/kg; SAR(10 g) = 1.62 W/kg Smallest distance from peaks to all points 3 dB below = 17 mm Ratio of SAR at M2 to SAR at M1 = 67.4% Maximum value of SAR (measured) = 3.25 W/kg



0 dB = 3.25 W/kg = 5.12 dBW/kg

Impedance Measurement Plot for Head TSL

ile	⊻iew	Channel	Sweep	Calibration	Trace	<u>S</u> cale	M <u>a</u> rker	System	Window	He	lp				
					ſ	4	X	EX X	X		55.9) MHz 105 pF) MHz	34	50, 19(3, 4094 1, 064 r -84, 76	4Ω mU
					Ę	ł	Ł		Ì	7					
		Ch 1 Avg =	20			X			X						
10.00	n1: Star	rt 635.000 B \$11	MHz —	-				>	1 83	5 d	00000	МНа		1.03500	
10.00 5.00	n1: Star	rt 635.000	MHz —					>	1: 83	15. di	00000	MHz		1.03500 9.354	
10.00 5.00 0.00 -5.00	a1: Star	rt 635.000	MHz					>	1: 83	5.0	00000	MHz		-	
10.00 5.00 0.00 5.00 -10.00	1: Star	rt 635.000	MHz					>	1 83	5.0	00000	MHz		-	
10.00 5.00 0.00 5.00 10.00 15.00	al: Star	rt 635.000	MHz					,	1 83	5.0	00000	MHz		-	
10.00 5.00 0.00 5.00 -10.00 -15.00 20.00	d	rt 635.000						>	1 83	85.Q	00000	MHz		-	
10.00 5.00 5.00 5.00 10.00 15.00 20.00 25.00	di	rt 635.000	MHz					, , , ,	1 83	15.C	00000	MHz		-	
10.00 5.00 -5.00 -10.00 -15.00 -20.00 25.00 30.00	1: Star	rt 635.000	MHz					,	1 83	5.0	00000	MHz		-	
10.00 5.00 -5.00 -10.00 -15.00 20.00 25.00 30.00 35.00 40.00	al: Star	Ch 1 Avg =	20					, , , ,	1 83	5.0	00000	MHz		-	-
10.00 5.00 -5.00 -10.00 -15.00 20.00 25.00 30.00 35.00 40.00	al: Star	rt 635.000	20					,	1 83	15.0		MHz	-2	9.354	dB
10.00 5.00 5.00 10.00 15.00 20.00 25.00 30.00 35.00	1: Start	tt 635.000 B S11 Sh 1 Avg = So 55.000 №	20		C* 1-Port			> 		5.0		MHz	-2	-	dB