



In Collaboration with

e CALIBRATION LABORATORY

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#### Glossary:

TSL ConvF N/A

tissue simulating liquid sensitivity in TSL / NORMx,y,z 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 assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- d) KDB865664, 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%.

Certificate No: Z21-60172

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
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	38.7 ± 6 %	1.95 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

# SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (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	56.8 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	4
SAR measured	250 mW input power	6.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.8 W/kg ± 18.7 % (k=2)

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#### Appendix(Additional assessments outside the scope of CNAS L0570)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.0Ω- 6.30jΩ	
Return Loss	- 24.0dB	

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.059 ns
Electrical Belay (one direction)	1.000 110

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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DASY5 Validation Report for Head TSL

Date: 05.19.2021

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1095

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2600 MHz;  $\sigma$  = 1.953 S/m;  $\epsilon_r$  = 38.72;  $\rho$  = 1000 kg/m<sup>3</sup>

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(7.3, 7.3, 7.3) @ 2600 MHz; Calibrated: 2021-04-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 2021-01-08
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

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

Reference Value = 105.6 V/m; Power Drift = -0.04 dB

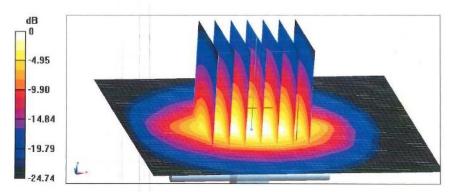
Peak SAR (extrapolated) = 31.9 W/kg

SAR(1 g) = 14.2 W/kg; SAR(10 g) = 6.2 W/kg

Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 44.2%

Maximum value of SAR (measured) = 25.0 W/kg



0 dB = 25.0 W/kg = 13.98 dBW/kg

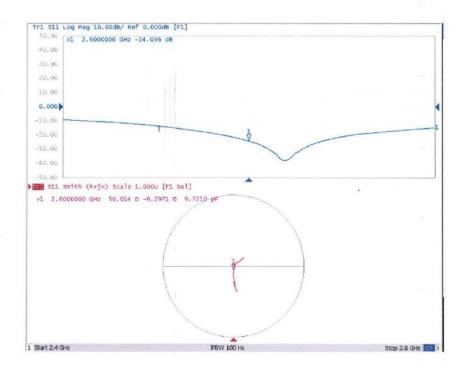
Certificate No: Z21-60172

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#### Impedance Measurement Plot for Head TSL



Certificate No: Z21-60172

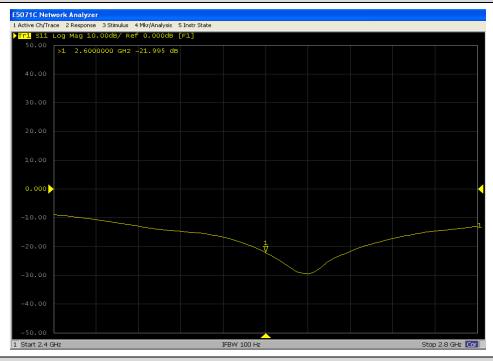
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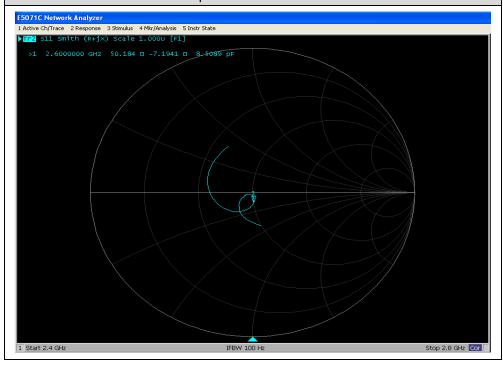
# D2600V2 Dipole impedance and return loss Validation

Meas. Results	Current Meas.	Previous Meas.	Max. Deviation
Meas. Data	2022.05.18	2021.05.19	/
Return Loss(dB)	-21.995	-24.036	-8.49%
l man a dan a a	F0 104 O 7 104 :O	50.014 Ω - 6.297	-0.897Ω
Impedance	50.184 Ω - 7.194 jΩ	jΩ	(Imaginary part)

# Return Loss for Head TSL



# Impedance for Head TSL





# F.8 3.5GHz Dipole

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





S Schweizerischer Kallbrierdienst
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

Client Balun-SZ (Auden)

Certificate No: D3500V2-1115 Nov20

Object	D3500V2 - SN:11	15	
Calibration procedure(s)	QA CAL-22.v5		
	Calibration Proce	dure for SAR Validation Sources	between 3-10 GHz
Calibration date:	November 11, 20	20	
	The said to provide all the second state of the construction of the	onal standards, which realize the physical un	(INCONTRACTOR OF STREET, CONTRACTOR (INCOME CONTRACTOR OF
The measurements and the uncert	ainties with confidence p	robability are given on the following pages an	d are part of the certificate.
All calibrations have been conduct	ad in the closed laborator	y facility: environment temperature (22 ± 3)°C	C and humidity < 70%
All Calibrations have been conduct	ed in the closed laborator	y lacility. environment temperature (22 ± 3) (	o and namenty < 10 %;
		y lacinty, environment temperature (22 ± 3) (	and namely a 70%.
	E critical for calibration)	y lacility. environment temperature (22 ± 3) (	
Calibration Equipment used (M&TE	E critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
Callibration Equipment used (M&TE Primary Standards Power meter NRP	E critical for calibration)  ID #  SN: 104778	Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100/03101)	Scheduled Calibration Apr-21
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91	ID # SN: 104778 SN: 103244	Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100)	Scheduled Calibration Apr-21 Apr-21
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	ID # SN: 104778 SN: 103244 SN: 103245	Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101)	Scheduled Calibration Apr-21 Apr-21 Apr-21
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	E critical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	E critical for calibration)  ID #  SN: 104778  SN: 103244  SN: 103245  SN: BH9394 (20k)  SN: 310982 / 06327	Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	E critical for calibration)  ID #  SN: 104778  SN: 103244  SN: 103245  SN: BH9394 (20k)  SN: 310982 / 06327  SN: 3503	Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	E critical for calibration)  ID #  SN: 104778  SN: 103244  SN: 103245  SN: BH9394 (20k)  SN: 310982 / 06327	Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104)	Scheduled Calibration Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	E critical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601  ID #	Cal Date (Certificate No.)  01-Apr-20 (No. 217-03100/03101)  01-Apr-20 (No. 217-03100)  01-Apr-20 (No. 217-03101)  31-Mar-20 (No. 217-03106)  31-Mar-20 (No. 217-03104)  31-Dec-19 (No. EX3-3503_Dec19)  02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house)	Scheduled Calibration  Apr-21  Apr-21  Apr-21  Apr-21  Apr-21  Dec-20  Nov-21  Scheduled Check
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	E critical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601  ID #  SN: GB39512475	Cal Date (Certificate No.)  01-Apr-20 (No. 217-03100/03101)  01-Apr-20 (No. 217-03100)  01-Apr-20 (No. 217-03101)  31-Mar-20 (No. 217-03106)  31-Mar-20 (No. 217-03104)  31-Dec-19 (No. EX3-3503_Dec19)  02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house)  30-Oct-14 (in house check Oct-20)	Scheduled Calibration  Apr-21  Apr-21  Apr-21  Apr-21  Apr-21  Dec-20  Nov-21  Scheduled Check  In house check: Oct-22
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	E critical for calibration)  ID #  SN: 104778  SN: 103244  SN: 103245  SN: BH9394 (20k)  SN: 310982 / 06327  SN: 3503  SN: 601  ID #  SN: GB39512475  SN: US37292783	Cal Date (Certificate No.) 01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Scheduled Calibration  Apr-21  Apr-21  Apr-21  Apr-21  Apr-21  Dec-20  Nov-21  Scheduled Check  In house check: Oct-22  In house check: Oct-22
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A	E critical for calibration)  ID #  SN: 104778  SN: 103244  SN: 103245  SN: BH9394 (20k)  SN: 310982 / 06327  SN: 3503  SN: 601  ID #  SN: GB39512475  SN: US37292783  SN: MY41092317	Cal Date (Certificate No.)  01-Apr-20 (No. 217-03100/03101)  01-Apr-20 (No. 217-03100)  01-Apr-20 (No. 217-03101)  31-Mar-20 (No. 217-03106)  31-Mar-20 (No. 217-03104)  31-Dec-19 (No. EX3-3503_Dec19)  02-Nov-20 (No. DAE4-601_Nov20)  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 Calibration  Apr-21  Apr-21  Apr-21  Apr-21  Apr-21  Dec-20  Nov-21  Scheduled Check  In house check: Oct-22  In house check: Oct-22  In house check: Oct-22
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Certificate No: D3500V2-1115\_Nov20

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





S Schweizerischer Kalibrierdienst
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:

TSL

tissue simulating liquid

ConvF N/A sensitivity in TSL / NORM x,y,z 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
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- 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.
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  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%.

Certificate No: D3500V2-1115\_Nov20

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#### **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 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	3400 MHz ± 1 MHz 3500 MHz ± 1 MHz	

# Head TSL parameters at 3400 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	38.0	2.81 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.9 ± 6 %	2.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL at 3400 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.66 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	65.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.51 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.9 W/kg ± 19.5 % (k=2)

# Head TSL parameters at 3500 MHz

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) °C	36.8 ± 6 %	2.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL at 3500 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.74 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	66.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (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 ± 19.5 % (k=2)

Certificate No: D3500V2-1115\_Nov20



# Appendix (Additional assessments outside the scope of SCS 0108)

# Antenna Parameters with Head TSL at 3400 MHz

Impedance, transformed to feed point	$41.5 \Omega + 0.4 j\Omega$	
Return Loss	- 20.7 dB	

# Antenna Parameters with Head TSL at 3500 MHz

Impedance, transformed to feed point	$46.2 \Omega + 5.0 j\Omega$	
Return Loss	- 23.7 dB	

# General Antenna Parameters and Design

Electrical Delay (one direction)	1.137 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**

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#### **DASY5 Validation Report for Head TSL**

Date: 11.11.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN:1115

Communication System: UID 0 - CW; Frequency: 3500 MHz, Frequency: 3400 MHz Medium parameters used: f=3500 MHz;  $\sigma=2.94$  S/m;  $\epsilon_r=36.8;~\rho=1000$  kg/m $^3$ , Medium parameters used: f=3400 MHz;  $\sigma=2.86$  S/m;  $\epsilon_r=36.9;~\rho=1000$  kg/m $^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(7.91, 7.91, 7.91) @ 3500 MHz, ConvF(7.91, 7.91, 7.91) @ 3400 MHz; Calibrated: 31.12.2019
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

### Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3500MHz/Zoom Scan,

dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 70.85 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 17.9 W/kg

SAR(1 g) = 6.74 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 = 74.9%

Maximum value of SAR (measured) = 12.6 W/kg

# Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3400MHz/Zoom Scan,

dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 70.46 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.5 W/kg

SAR(1 g) = 6.66 W/kg; SAR(10 g) = 2.51 W/kg

Smallest distance from peaks to all points 3 dB below = 8 mm

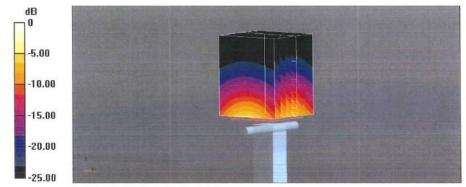
Ratio of SAR at M2 to SAR at M1 = 75.3%

Maximum value of SAR (measured) = 12.4 W/kg

Certificate No: D3500V2-1115\_Nov20

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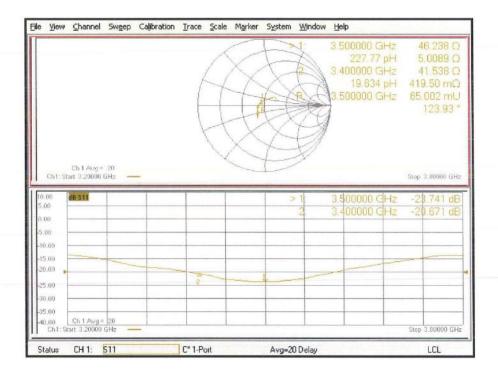


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#### Impedance Measurement Plot for Head TSL



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D3400V2 Dipole impedance and return loss Validation

ipole impedance and	ole impedance and return loss Validation					
Meas. Results	Current Meas.	Previous Meas.	Max. Deviation			
Meas. Data	2021.11.10	2020.11.11	/			
Return Loss(dB)	Return Loss(dB) -20.532 -20.671 -0.67%					
Impodance	Impedance $39.861 \Omega + 2.590  41.538 \Omega + 0.420  2.17\Omega$					
j $\Omega$ j $\Omega$ (Imaginary part)						
Return Loss for Head TSL						
▶ <mark>Tr1</mark> S11 Log Mag 10.00dB, 50.00						
3.4000000 ( 40.00	5HZ -20.532 dB					
30.00						
20.00						
10.00						
0.000			1			
-10.00	1 ▽		1			
-20.00						
-30.00						
-50.00						
1 Start 3.2 GHz	IFBW 100		Stop 3.8 GHz Cor !			
▶Tr1 S11 Smith (R+j×) Sca	Impedance f	or Head TSL				
	861 Ω 2.5904 Ω 121.726 рн					
	1					
1 Start 3.2 GHz	IFBW 100	i Hz	Stop 3.8 GHz Cor I			



# D3500V2 Dipole impedance and return loss Validation

ole impedance and return loss Validation					
Meas. Results	Current Meas.	Previous Meas.	Max. Deviation		
Meas. Data	2021.11.10	2020.11.11	/		
Return Loss(dB)	-24.898	-23.741	4.87%		
Impodance	50.132 Ω + 0.136	46.238 Ω + 5.009	-4.873Ω		
Impedance $j\Omega$ $j\Omega$ (Imaginary part)					
	Return Loss f	for Head TSL			
Tr1 S11 Log Mag 10.00dB/					
30.00 >1 3.5000000 G	12 -24.898 dB				
20.00					
0.000					
-10.00					
-20.00		7			
-40.00					
-50.00	V				
1 Start 3.2 GHz	IFBW 100		Stop 3.8 GHz Cor I		
▶Tr1 S11 Smith (R+i×) Sca	Impedance f	or Head ISL			
Tr1 S11 Smith (R+jX) Sca >1 3.5000000 GHz 50.1	FEW 100	Hz	Stop 3.8 GHz Cor		



# F.9 3.7GHz Dipole

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





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

Object	D3700V2 - SN:1086			
Calibration procedure(s)	QA CAL-22.v5 Calibration Proce	dure for SAR Validation Sources	between 3-10 GHz	
Calibration date:	November 12, 20	20		
		onal standards, which realize the physical un robability are given on the following pages an	And the second s	
All calibrations have been conducte	ed in the closed laborator	y facility: environment temperature (22 ± 3)°C	C and humidity < 70%.	
Calibration Equipment used (M&TE	critical for calibration)			
Primary Standards	ID#	Cal Date (Certificate No.)	0.1-1.1-1.0-11-11-1	
minuty Standards	1.00	our bate (our timeate 140.)	Scheduled Calibration	
	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21	
Power meter NRP				
Power meter NRP Power sensor NRP-Z91	SN: 104778	01-Apr-20 (No. 217-03100/03101)	Apr-21	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 104778 SN: 103244	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100)	Apr-21 Apr-21	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 104778 SN: 103244 SN: 103245	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101)	Apr-21 Apr-21 Apr-21	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106)	Apr-21 Apr-21 Apr-21 Apr-21	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dac-19 (No. EX3-3503_Dec19) 02-Nov-20 (No. DAE4-601_Nov20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Nov-21	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Nov-21 Scheduled Check	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Nov-21 Scheduled Check In house check: Oct-22	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03106) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 02-Nov-20 (No. DAE-4-601_Nov20)  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)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Nov-21  Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Dec-19 (No. EX3-3503_Dec19) 02-Nov-20 (No. DAE4-601_Nov20)  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)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Nov-21 Scheduled Check In house check; Oct-22 In house check; Oct-22 In house check; Oct-22 In house check; Oct-22	
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	01-Apr-20 (No. 217-03100/03101) 01-Apr-20 (No. 217-03100) 01-Apr-20 (No. 217-03101) 31-Mar-20 (No. 217-03101) 31-Mar-20 (No. 217-03104) 31-Dac-19 (No. EX3-3503_Dec19) 02-Nov-20 (No. DAE4-601_Nov20) 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) 31-Mar-14 (in house check Oct-20)	Apr-21 Apr-21 Apr-21 Apr-21 Apr-21 Dec-20 Nov-21 Scheduled Check In house check: Oct-22	

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





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Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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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%.

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# **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	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
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) °C	36.5 ± 6 %	3.09 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.63 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	66.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 19.5 % (k=2)

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# Appendix (Additional assessments outside the scope of SCS 0108)

#### **Antenna Parameters with Head TSL**

Impedance, transformed to feed point	46.1 $\Omega$ + 0.1 j $\Omega$	
Return Loss	- 27.8 dB	

# **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.105 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the 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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# **DASY5 Validation Report for Head TSL**

Date: 12.11.2020

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN:1086

Communication System: UID 0 - CW; Frequency: 3700 MHz

Medium parameters used: f = 3700 MHz;  $\sigma = 3.09 \text{ S/m}$ ;  $\varepsilon_r = 36.5$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

Probe: EX3DV4 - SN3503; ConvF(7.73, 7.73, 7.73) @ 3700 MHz; Calibrated: 31.12.2019

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

Electronics: DAE4 Sn601; Calibrated: 02.11.2020

Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001

DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

# Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3700MHz/Zoom Scan,

dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 69.99 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 18.6 W/kg

SAR(1 g) = 6.63 W/kg; SAR(10 g) = 2.4 W/kg

Smallest distance from peaks to all points 3 dB below = 8 mm

Ratio of SAR at M2 to SAR at M1 = 73.8%

Maximum value of SAR (measured) = 12.8 W/kg



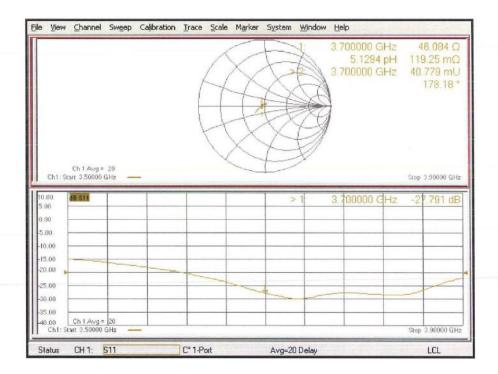
0 dB = 12.8 W/kg = 11.07 dBW/kg

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# Impedance Measurement Plot for Head TSL



Certificate No: D3700V2-1086\_Nov20



# D3700V2 Di

Meas. Results	ipole impedance and	return loss Validatio	n	
Return Loss(dB)   -29.433   -27.791   5.91%     Impedance	Meas. Results	Current Meas.	Previous Meas.	Max. Deviation
Impedance  47.778 Ω + 2.474  jΩ  Return Loss for Head TSL    Impedance   10.0006/ Ref 0.00006 (F1)   10.0000   10.000   10.000   10.000   10.000   10.000   10.000   10.0000   10.000   10.000   10.000   10.000   10.000   10.000   10.0000   10.000   10.000   10.000   10.000   10.000   10.000   10.0000   10.000   10.000   10.000   10.000   10.000   10.000   10.0000   10.000   10.000   10.000   10.000   10.000   10.000   10.0000   10.000   10.000   10.000   10.000   10.000   10.000   10.0000   10.000   10.000   10.000   10.000   10.000   10.000   10.0000   10.000   10.000   10.000   10.000   10.000   10.000   10.0000   10.000   10.000   10.000   10.000   10.000   10.000   10.0000	Meas. Data	2021.11.10 2020.11.12		/
Impedance   jΩ   jΩ   (Imaginary part)	Return Loss(dB)	-29.433 -27.791		5.91%
Return Loss for Head TSL    1	Impodance	47.778 Ω + 2.474	46.084 Ω + 0.119	2.355Ω
Size   Size   Log Mag   10.00db / Ref   0.000db   Fel   1.000   1.00	impedance	jΩ	jΩ	(Imaginary part)
30.00 20.00 10.00 -10.00 -20.00 -30.00  1 Start 3.5 GHz  Impedance for Head TSL  Impedance for Head TSL			for Head TSL	
	Tri   Sil Log Mag   10.00d8/   50.00   >1 3.7000000 G   40.00     20.00     20.00	jΩ  Return Loss f  Ref 0.000dB [F1]  Hz -29.433 dB  IFBW 100  Impedance f	jΩ for Head TSL	(Imaginary part)
1 Start 3.5 GHz	1 Start 3.5 GHz	IFBW 100	) Hz	Stop 3.9 GHz Cor I



# F.103.9GHz Dipole

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





S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S 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

Client Balun-SZ (Auden)

Certificate No: D3900V2-1059\_Nov20

	D0000010 00140	250	
Object	D3900V2 - SN:10	059	
Calibration procedure(s)	QA CAL-22.v5		
	Calibration Proce	dure for SAR Validation Sources	between 3-10 GHz
Calibration date:	November 13, 20	20	
This calibration certificate documen	nts the traceability to nati	onal standards, which realize the physical un	its of measurements (SI).
		robability are given on the following pages an	
20 22 2 2			2
All calibrations have been conducte	ed in the closed laborator	y facility: environment temperature (22 ± 3)°0	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	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
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 3503	31-Dec-19 (No. EX3-3503_Dec19)	Dec-20
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
		Laboratory Technician	
Calibrated by:	Claudio Leubler	Laboratory recrimician	
Calibrated by:		Laboratory Technician	yel
Calibrated by:  Approved by:		Technical Manager	and a
- =	Claudio Leubler	133700000000000000000000000000000000000	May

Certificate No: D3900V2-1059\_Nov20

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





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Swiss Calibration Service

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Accredited by the Swiss Accreditation Service (SAS)

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#### Glossary:

TSL

tissue simulating liquid

ConvF N/A sensitivity in TSL / NORM x,y,z 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
- EC 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%.

Certificate No: D3900V2-1059\_Nov20

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#### **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 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	3900 MHz ± 1 MHz 4100 MHz ± 1 MHz	

# Head TSL parameters at 3900 MHz

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) °C	36.3 ± 6 %	3.25 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		****

# SAR result with Head TSL at 3900 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.95 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	69.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.9 W/kg ± 19.5 % (k=2)

# Head TSL parameters at 4100 MHz The following parameters and calculations

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.2	3.53 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.0 ± 6 %	3.42 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL at 4100 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.74 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	67.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 W/kg ± 19.5 % (k=2)

Certificate No: D3900V2-1059\_Nov20

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### Appendix (Additional assessments outside the scope of SCS 0108)

# Antenna Parameters with Head TSL at 3900 MHz

Impedance, transformed to feed point	$48.8 \Omega - 6.4 j\Omega$	
Return Loss	- 23.6 dB	

### Antenna Parameters with Head TSL at 4100 MHz

Impedance, transformed to feed point	$58.7 \Omega + 0.0 j\Omega$	
Return Loss	- 21.9 dB	

# **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.113 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
······································	0.2.0

Certificate No: D3900V2-1059\_Nov20

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#### **DASY5 Validation Report for Head TSL**

Date: 13.11.2020

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 3900 MHz; Type: D3900V2; Serial: D3900V2 - SN:1059

Communication System: UID 0 - CW; Frequency: 3900 MHz, Frequency: 4100 MHz Medium parameters used: f=3900 MHz;  $\sigma=3.25$  S/m;  $\epsilon_r=36.3;$   $\rho=1000$  kg/m $^3$ , Medium parameters used: f=4100 MHz;  $\sigma=3.42$  S/m;  $\epsilon_r=36;$   $\rho=1000$  kg/m $^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(7.39, 7.39, 7.39) @ 3900 MHz, ConvF(7.26, 7.26, 7.26) @ 4100 MHz; Calibrated: 31.12.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

# Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3900MHz/Zoom Scan,

dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 72.75 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 19.7 W/kg

SAR(1 g) = 6.95 W/kg; SAR(10 g) = 2.41 W/kg

Smallest distance from peaks to all points 3 dB below = 7.9 mm

Ratio of SAR at M2 to SAR at M1 = 74%

Maximum value of SAR (measured) = 13.6 W/kg

### Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=4100MHz/Zoom Scan,

dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 70.43 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 19.2 W/kg

SAR(1 g) = 6.74 W/kg; SAR(10 g) = 2.33 W/kg

Smallest distance from peaks to all points 3 dB below = 7.9 mm

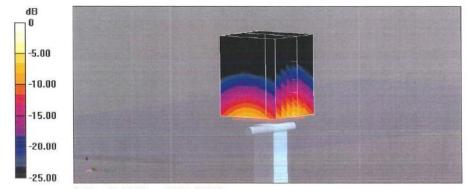
Ratio of SAR at M2 to SAR at M1 = 73.9%

Maximum value of SAR (measured) = 13.5 W/kg

Certificate No: D3900V2-1059\_Nov20

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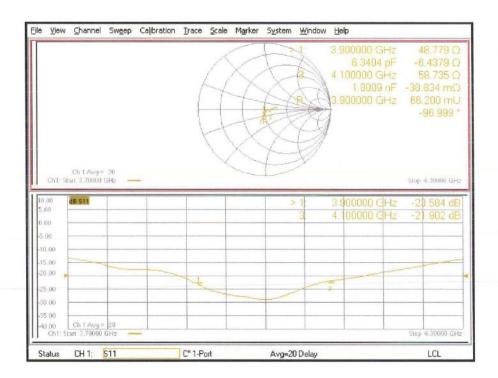
0 dB = 13.6 W/kg = 11.34 dBW/kg

Certificate No: D3900V2-1059\_Nov20

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#### Impedance Measurement Plot for Head TSL



Certificate No: D3900V2-1059\_Nov20

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# D3900V2 D

Meas. Results	Current Meas.	Previous Meas.	Max. Deviation
Meas. Data	2021.11.10	2020.11.13	/
Return Loss(dB)	-22.647	-23.584	-3.97%
	51.801 Ω – 7.177	48.779 Ω – 6.438	3.022Ω
Impedance	jΩ	jΩ	(Real part)
	Return Loss	for Head TSL	
▶Tr1 S11 Log Mag 10.00d			
>1 3.9000000	GHz -22.647 dB		
40.00			
30.00			
30.00			
20.00			
10.00			
10.00			
0.000			
-10.00			
-10.00			
-20.00	1		
-30.00			
-50.00			
-40.00			
-50.00			
1 Start 3.7 GHz	IFBW :	LOO Hz	Stop 4.3 GHz Cor
	Impedance	for Head TSL	
▶Tr1 S11 Smith (R+j×) S			
>1 3.9000000 GHz 51	.801 Ω -7.1770 Ω 5.6861 pF		
/			
/		$\times$	
		1	
		91	

IFBW 100 Hz

1 Start 3.7 GHz

Stop 4.3 GHz Cor !



D4100V2 Dipole impedance and return loss Validation

Meas. Results	Current Meas.	Previous Meas.	Max. Deviation		
Meas. Data	2021.11.10	2020.11.13	/		
Return Loss(dB)	-20.022	-21.902	-8.58%		
Return Loss(ub)	-20.022 56.876 Ω – 2.324	58.735 Ω – 0.039	-8.38%		
Impedance					
	jΩ	jΩ	(Imaginary part)		
▶Tr1 s11 Log Mag 10.00db/	Return Loss 1	or Head TSL			
50.00 >1 4.1000000 G					
40.00					
30.00					
20.00					
20.00					
10.00					
0.000					
4.000					
-10.00					
		1			
-20.00		1			
-30.00					
-40.00					
-50.00					
1 Start 3.7 GHz	IFBW 100		Stop 4.3 GHz Cor		
▶Tr1 S11 Smith (R+j×) Sca	Impedance f	or nead 13L			
>1 4.1000000 GHz 56.8	376 Ω -2.3244 Ω 5-5716 pF				
1 Start 3.7 GHz	IFBW 100	Hz	Stop 4.3 GHz Cor I		



# F.115GHz Dipole



Client

baluntek

Certificate No:

Z21-60173

# **CALIBRATION CERTIFICATE**

Object

D5GHzV2 - SN: 1200

Calibration Procedure(s)

FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date:

May 18, 2021

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  $(22\pm3)^{\circ}$ 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	106277	23-Sep-20 (CTTL, No.J20X08336)	Sep-21
Power sensor NRP8S	104291	23-Sep-20 (CTTL, No.J20X08336)	Sep-21
ReferenceProbe EX3DV4	SN 3846	26-Apr-21(CTTL-SPEAG,No.Z21-60084)	Apr-22
DAE4	SN 777	08-Jan-21(CTTL-SPEAG,No.Z21-60003)	Jan-22
Secondary Standards	ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	25-Feb-20 (CTTL, No.J20X00516)	Feb-21
NetworkAnalyzerE5071C	MY46110673	10-Feb-20 (CTTL, No.J20X00515)	Feb-21
	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	多重
Reviewed by:	Lin Hao	SAR Test Engineer	林光
Approved by:	Qi Dianyuan	SAR Project Leader	26
		Issued: May	24, 2021
This calibration certificate s	hall not be repro	duced except in full without written approval	of the laboratory.

Certificate No: Z21-60173

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Glossary:

TSL ConvF N/A tissue simulating liquid sensitivity in TSL / NORMx,y,z 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 assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- d) KDB865664, 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%.

Certificate No: Z21-60173

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	1

#### 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	35.5 ± 6 %	4.67 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °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	7.80 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.8 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.1 W/kg ± 24.2 % (k=2)

Certificate No: Z21-60173

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# Head TSL parameters at 5600 MHz

	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	34.9 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °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	8.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.2 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 W/kg ± 24.2 % (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	34.7 ± 6 %	5.21 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

# SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	80
SAR measured	100 mW input power	7.75 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.2 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.7 W/kg ± 24.2 % (k=2)

Certificate No: Z21-60173

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Body TSL parameters at 5250 MHz
The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.1 ± 6 %	5.34 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 $cm^3$ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.33 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	73.4 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.05 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.5 W/kg ± 24.2 % (k=2)

Body TSL parameters at 5600 MHz
The following parameters and calculations were applied.

fi	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.4 ± 6 %	5.82 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	1222	

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 $cm^3$ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.72 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.2 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 W/kg ± 24.2 % (k=2)

Certificate No: Z21-60173

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# Body TSL parameters at 5750 MHz The following parameters and salarity:

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.1 ± 6 %	6.05 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 $cm^3$ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.34 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	73.4 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.3 W/kg ± 24.2 % (k=2)

Certificate No: Z21-60173

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# Appendix (Additional assessments outside the scope of CNAS L0570)

#### Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	$45.1\Omega + 1.25j\Omega$	
Return Loss	- 25.5dB	

#### Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	$49.7\Omega + 7.81j\Omega$
Return Loss	- 22.1dB

# Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	$45.9\Omega + 4.85j\Omega$	
Return Loss	- 23.5dB	

# Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	$43.9\Omega + 2.08j\Omega$	
Return Loss	- 23.3dB	

# Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	50.3Ω + 8.89jΩ	
Return Loss	- 21.1dB	

# Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	$46.6\Omega + 5.63j\Omega$	
Return Loss	- 23.3dB	

Certificate No: Z21-60173

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### General Antenna Parameters and Design

[	4 000
Electrical Delay (one direction)	1.096 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: 05.18.2021



Add: No.52 HuaYuanBci Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504 http://www.chinattl.cn

#### DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1200

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,

Medium parameters used: f = 5250 MHz;  $\sigma$  = 4.668 S/m;  $\epsilon_r$  = 35.48;  $\rho$  = 1000 kg/m³, Medium parameters used: f = 5600 MHz;  $\sigma$  = 5.045 S/m;  $\epsilon_r$  = 34.88;  $\rho$  = 1000 kg/m³, Medium parameters used: f = 5750 MHz;  $\sigma$  = 5.208 S/m;  $\epsilon_r$  = 34.67;  $\rho$  = 1000 kg/m³,

Phantom section: Center Section

#### DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(5.43, 5.43, 5.43) @ 5250 MHz; ConvF(4.69, 4.69, 4.69) @ 5600 MHz; ConvF(4.9, 4.9, 4.9) @ 5750 MHz; Calibrated: 2021-04-26
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 2021-01-08
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 69.22 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 32.9 W/kg

SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.22 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 63.3%

Maximum value of SAR (measured) = 18.9 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 70.18 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 35.5 W/kg

SAR(1 g) = 8.15 W/kg; SAR(10 g) = 2.32 W/kg

Smallest distance from peaks to all points 3 dB below = 7.4 mm

Ratio of SAR at M2 to SAR at M1 = 62.9%

Maximum value of SAR (measured) = 19.8 W/kg

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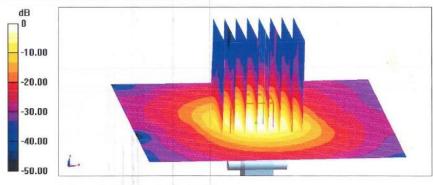




Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 68.06 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 34.6 W/kg
SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.18 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm

Ratio of SAR at M2 to SAR at M1 = 62.1%

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



0 dB = 19.0 W/kg = 12.79 dBW/kg

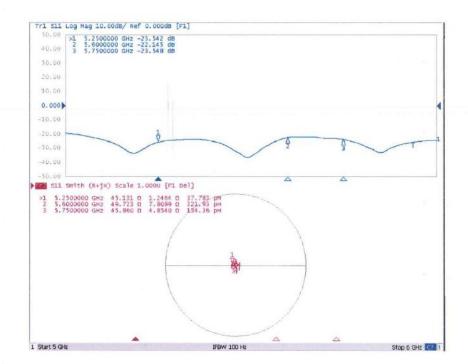
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# Impedance Measurement Plot for Head TSL



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**DASY5 Validation Report for Body TSL** 

Date: 05.18.2021

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1200

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,

Medium parameters used: f = 5250 MHz;  $\sigma$  = 5.34 S/m;  $\epsilon_r$  = 49.12;  $\rho$  = 1000 kg/m³, Medium parameters used: f = 5600 MHz;  $\sigma$  = 5.815 S/m;  $\epsilon_r$  = 48.44;  $\rho$  = 1000 kg/m³, Medium parameters used: f = 5750 MHz;  $\sigma$  = 6.045 S/m;  $\epsilon_r$  = 48.11;  $\rho$  = 1000 kg/m³.

Phantom section: Right Section

#### DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(4.95, 4.95, 4.95) @ 5250 MHz; ConvF(4.32, 4.32, 4.32) @ 5600 MHz; ConvF(4.38, 4.38, 4.38) @ 5750 MHz; Calibrated: 2021-04-26,
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 2021-01-08
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.86 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 29.6 W/kg

SAR(1 g) = 7.33 W/kg; SAR(10 g) = 2.05 W/kg

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

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

Maximum value of SAR (measured) = 17.2 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.06 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 33.1 W/kg

SAR(1 g) = 7.72 W/kg; SAR(10 g) = 2.16 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 63.1%

Maximum value of SAR (measured) = 18.8 W/kg

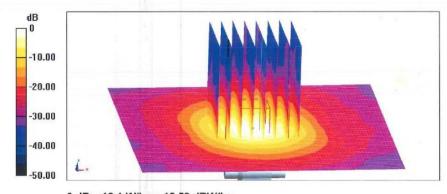
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Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 64.58 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 32.8 W/kg
SAR(1 g) = 7.34 W/kg; SAR(10 g) = 2.03 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 62%
Maximum value of SAR (measured) = 18.1 W/kg



0 dB = 18.1 W/kg = 12.58 dBW/kg

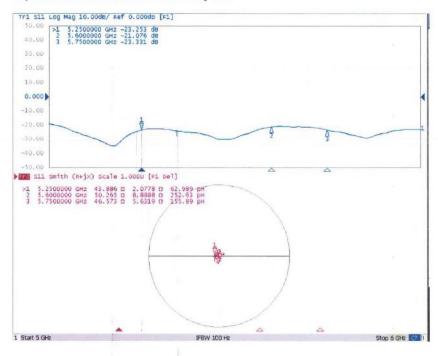
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# Impedance Measurement Plot for Body TSL



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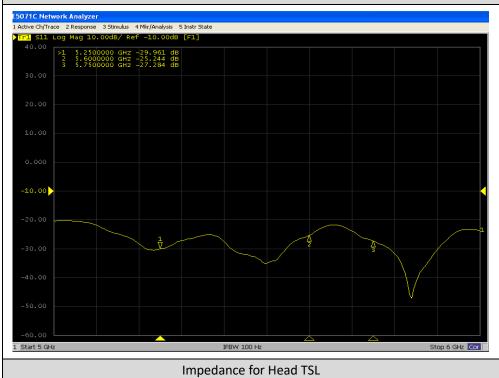
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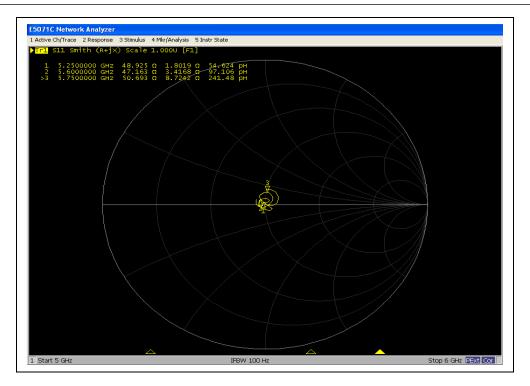
D5GHzV2 Dipole impedance and return loss Validation

Meas. Results	Current Meas.	Previous Meas.	Max. Deviation
Meas. Data	2022.05.17	2021.05.18	/
5.25GHz	20.064	-25.542	17.30%
Return Loss(dB)	-29.961	-23.542	17.50%
5.25GHz	48.925 Ω +1.802 jΩ	45.131 Ω +1.246	3.794Ω
Impedance		jΩ	(Real part)
5.6GHz	-25.244	-22.145	13.99%
Return Loss(dB)		-22.145	15.99%
5.6GHz	47.163Ω +3.417 jΩ	49.723 Ω +7.809	-4.392Ω
Impedance		jΩ	(Imaginary part)
5.75GHz	-27.284	-23.548	15.87%
Return Loss(dB)	-27.204	-23.546	15.67 //
5.75GHz	50.693Ω +8.724 jΩ	45.860 Ω +4.854	4.833Ω
Impedance		jΩ	(Real part)

# Return Loss for Head TSL







--END OF REPORT--