

EX3DV4 - SN:3677 July 20, 2023

UID	Rev	Communication System Name	Group	PAR (dB)	$Unc^{E} k = 2$
10983	AAA	5G NR DL (CP-OFDM, TM 3.1, 40 MHz, 64-QAM, 15 kHz)	5G NR FR1 TDD	9.31	±9.6
10984	AAA	5G NR DL (CP-OFDM, TM 3.1, 50 MHz, 64-QAM, 15 kHz)	5G NR FR1 TDD	9.42	±9.6
10985	AAA	5G NR DL (CP-OFDM, TM 3.1, 40 MHz, 64-QAM, 30 kHz)	5G NR FR1 TDD	9.54	±9.6
10986	AAA	5G NR DL (CP-OFDM, TM 3.1, 50 MHz, 64-QAM, 30 kHz)	5G NR FR1 TDD	9.50	±9.6
10987	AAA	5G NR DL (CP-OFDM, TM 3.1, 60 MHz, 64-QAM, 30 kHz)	5G NR FR1 TDD	9.53	±9.6
10988	AAA	5G NR DL (CP-OFDM, TM 3.1, 70 MHz, 64-QAM, 30 kHz)	5G NR FR1 TDD	9.38	±9.6
10989	AAA	5G NR DL (CP-OFDM, TM 3.1, 80 MHz, 64-QAM, 30 kHz)	5G NR FR1 TDD	9.33	±9.6
10990	AAA	5G NR DL (CP-OFDM, TM 3.1, 90 MHz, 64-QAM, 30 kHz)	5G NR FR1 TDD	9.52	±9.6
11003	AAA	5G NR DL (CP-OFDM, TM 3.1, 30 MHz, 64-QAM, 15 kHz)	5G NR FR1 TDD	10.24	±9.6
11004	AAA	5G NR DL (CP-OFDM, TM 3.1, 30 MHz, 64-QAM, 30 kHz)	5G NR FR1 TDD	10.73	±9.6
11005	AAA	5G NR DL (CP-OFDM, TM 3.1, 25 MHz, 64-QAM, 15 kHz)	5G NR FR1 FDD	8.70	±9.6
11006	AAA	5G NR DL (CP-OFDM, TM 3.1, 30 MHz, 64-QAM, 15 kHz)	5G NR FR1 FDD	8.55	±9.6
11007	AAA	5G NR DL (CP-OFDM, TM 3.1, 40 MHz, 64-QAM, 15 kHz)	5G NR FR1 FDD	8.46	±9.6
11008	AAA	5G NR DL (CP-OFDM, TM 3.1, 50 MHz, 64-QAM, 15 kHz)	5G NR FR1 FDD	8.51	±9.6
11009	AAA	5G NR DL (CP-OFDM, TM 3.1, 25 MHz, 64-QAM, 30 kHz)	5G NR FR1 FDD	8.76	±9.6
11010	AAA	5G NR DL (CP-OFDM, TM 3.1, 30 MHz, 64-QAM, 30 kHz)	5G NR FR1 FDD	8.95	±9.6
11011	AAA	5G NR DL (CP-OFDM, TM 3.1, 40 MHz, 64-QAM, 30 kHz)	5G NR FR1 FDD	8.96	±9.6
11012	AAA	5G NR DL (CP-OFDM, TM 3.1, 50 MHz, 64-QAM, 30 kHz)	5G NR FR1 FDD	8.68	±9.6
11013	AAA	IEEE 802.11be (320 MHz, MCS1, 99pc duty cycle)	WLAN	8.47	±9.6
11014	AAA	IEEE 802.11be (320 MHz, MCS2, 99pc duty cycle)	WLAN	8.45	±9.6
11015	AAA	IEEE 802.11be (320 MHz, MCS3, 99pc duty cycle)	WLAN	8.44	±9.6
11016	AAA	IEEE 802.11be (320 MHz, MCS4, 99pc duty cycle)	WLAN	8.44	±9.6
11017	AAA	IEEE 802.11be (320 MHz, MCS5, 99pc duty cycle)	WLAN	8.41	±9.6
11018	AAA	IEEE 802.11be (320 MHz, MCS6, 99pc duty cycle)	WLAN	8.40	±9.6
11019	AAA	IEEE 802.11be (320 MHz, MCS7, 99pc duty cycle)	WLAN	8.29	±9.6
11020	AAA	IEEE 802.11be (320 MHz, MCS8, 99pc duty cycle)	WLAN	8.27	±9.6
11021	AAA	IEEE 802.11be (320 MHz, MCS9, 99pc duty cycle)	WLAN	8.46	±9.6
11022	AAA	IEEE 802.11be (320 MHz, MCS10, 99pc duty cycle)	WLAN	8.36	±9.6
11023	AAA	IEEE 802.11be (320 MHz, MCS11, 99pc duty cycle)	WLAN	8.09	±9.6
11024	AAA	IEEE 802.11be (320 MHz, MCS12, 99pc duty cycle)	WLAN	8.42	±9.6
11025	AAA	IEEE 802.11be (320 MHz, MCS13, 99pc duty cycle)	WLAN	8.37	±9.6
11026	AAA	IEEE 802.11be (320 MHz, MCS0, 99pc duty cycle)	WLAN	8.39	±9.6

<sup>&</sup>lt;sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

Certificate No: EX-3677\_Jul23

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# **ANNEX E: D5GHzV2 Dipole Calibration Certificate**

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





Schweizerischer Kalibrierdienst Service suisse d'étalonnage

Report No.: R2403A0226-S1V1

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

Client

Auden

Certificate No: D5GHzV2-1203\_Dec22

Object	D5GHzV2 - SN:1	203			
Calibration procedure(s)	QA CAL-22.v7 Calibration Procedure for SAR Validation Sources between 3-10 GHz				
Calibration date:	December 09, 20	22			
	1. The contract of the contrac	onal standards, which realize the physical unitrobability are given on the following pages and	, ,		
All calibrations have been conducte	ed in the closed laborator	y facility: environment temperature (22 ± 3)°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	04-Apr-22 (No. 217-03525/03524)	Apr-23		
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23		
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23		
Reference 20 dB Attenuator	SN: BH9394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23		
Type-N mismatch combination	SN: 310982 / 06327	04-Apr-22 (No. 217-03528)	Apr-23		
	SN: 3503	08-Mar-22 (No. EX3-3503_Mar22)	Mar-23		
Reference Probe EX3DV4	SN: 601	31-Aug-22 (No. DAE4-601_Aug22)	Aug-23		
	SIN. 601				
DAE4	ID #	Check Date (in house)	Scheduled Check		
DAE4 Secondary Standards			Scheduled Check In house check: Oct-24		
DAE4 Secondary Standards Power meter E4419B	ID#	Check Date (in house)			
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	ID # SN: GB39512475	Check Date (in house) 30-Oct-14 (in house check Oct-22)	In house check: Oct-24		
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A	ID # SN: GB39512475 SN: US37292783	Check Date (in house) 30-Oct-14 (in house check Oct-22) 07-Oct-15 (in house check Oct-22)	In house check: Oct-24 In house check: Oct-24		
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	Check Date (in house) 30-Oct-14 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 07-Oct-15 (in house check Oct-22)	In house check: Oct-24 In house check: Oct-24 In house check: Oct-24		
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-22)  07-Oct-15 (in house check Oct-22)  07-Oct-15 (in house check Oct-22)  15-Jun-15 (in house check Oct-22)	In house check: Oct-24 In house check: Oct-24 In house check: Oct-24 In house check: Oct-24		
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-22)  07-Oct-15 (in house check Oct-22)  07-Oct-15 (in house check Oct-22)  15-Jun-15 (in house check Oct-22)  31-Mar-14 (in house check Oct-22)	In house check: Oct-24 In house check: Oct-24 In house check: Oct-24 In house check: Oct-24 In house check: Oct-24 Signature		
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  Calibrated by:  Approved by:	ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477 Name	Check Date (in house) 30-Oct-14 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 15-Jun-15 (in house check Oct-22) 31-Mar-14 (in house check Oct-22)	In house check: Oct-24 In house check: Oct-24 In house check: Oct-24 In house check: Oct-24 In house check: Oct-24		

Certificate No: D5GHzV2-1203\_Dec22

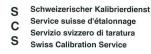
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Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland







Accreditation No.: SCS 0108

Report No.: R2403A0226-S1V1

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 sensitivity in TSL / NORM x,y,z N/A not applicable or not measured

#### Calibration is Performed According to the Following Standards:

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### **Additional Documentation:**

c) DASY System Handbook

#### Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end
  of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss: This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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

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

# Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.4 ± 6 %	4.61 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.76 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.7 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	2.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.4 W/kg ± 19.5 % (k=2)

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## Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.9 ± 6 %	4.98 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	****	

#### SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.3 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	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.0 W/kg ± 19.5 % (k=2)

#### Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.7 ± 6 %	5.14 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.68 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	76.8 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	2.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.0 W/kg ± 19.5 % (k=2)

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Head TSL parameters at 5850 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.2	5.32 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.6 ± 6 %	5.24 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	***	

#### SAR result with Head TSL at 5850 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.1 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	2.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.5 W/kg ± 19.5 % (k=2)

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**SAR Test Report** 



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

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

Impedance, transformed to feed point	48.5 Ω - 3.2 jΩ
Return Loss	- 29.0 dB

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

Impedance, transformed to feed point	51.7 Ω + 2.6 jΩ	
Return Loss	- 30.4 dB	

#### Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	53.6 Ω + 4.3 jΩ	
Return Loss	- 25.3 dB	

#### Antenna Parameters with Head TSL at 5850 MHz

Impedance, transformed to feed point	52.4 Ω + 4.2 jΩ	
Return Loss	- 26.5 dB	

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.191 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: 09.12.2022

Report No.: R2403A0226-S1V1

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1203

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5850 MHz

Medium parameters used: f = 5250 MHz;  $\sigma = 4.61$  S/m;  $\epsilon_r = 36.4$ ;  $\rho = 1000$  kg/m³, Medium parameters used: f = 5600 MHz;  $\sigma = 4.98$  S/m;  $\epsilon_r = 35.9$ ;  $\rho = 1000$  kg/m³, Medium parameters used: f = 5750 MHz;  $\sigma = 5.14$  S/m;  $\epsilon_r = 35.7$ ;  $\rho = 1000$  kg/m³,

Medium parameters used: f = 5850 MHz;  $\sigma = 5.24 \text{ S/m}$ ;  $\varepsilon_r = 35.6$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.5, 5.5, 5.5) @ 5250 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.08, 5.08, 5.08) @ 5750 MHz, ConvF(4.99, 4.99, 4.99) @ 5850 MHz; Calibrated: 08.03.2022
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 31.08.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

# Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan,

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

Reference Value = 73.31 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 26.3 W/kg

SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.24 W/kg

Smallest distance from peaks to all points 3 dB below = 7.5 mm

Ratio of SAR at M2 to SAR at M1 = 70.6%

Maximum value of SAR (measured) = 17.6 W/kg

# Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan,

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

Reference Value = 72.76 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 29.4 W/kg

SAR(1 g) = 8.02 W/kg; SAR(10 g) = 2.30 W/kg

Smallest distance from peaks to all points 3 dB below = 7.5 mm

Ratio of SAR at M2 to SAR at M1 = 67.9%

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

Certificate No: D5GHzV2-1203\_Dec22

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

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

Reference Value = 70.15 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 29.7 W/kg

SAR(1 g) = 7.68 W/kg; SAR(10 g) = 2.19 W/kg

Smallest distance from peaks to all points 3 dB below = 7.5 mm

Ratio of SAR at M2 to SAR at M1 = 66.2%

Maximum value of SAR (measured) = 18.3 W/kg

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

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

Reference Value = 70.55 V/m; Power Drift = -0.03 dB

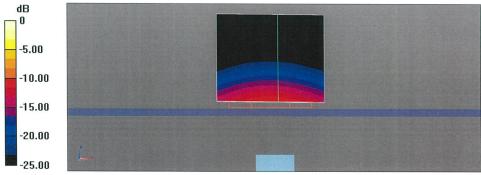
Peak SAR (extrapolated) = 31.6 W/kg

SAR(1 g) = 7.90 W/kg; SAR(10 g) = 2.25 W/kg

Smallest distance from peaks to all points 3 dB below = 7.5 mm

Ratio of SAR at M2 to SAR at M1 = 65.2%

Maximum value of SAR (measured) = 19.2 W/kg



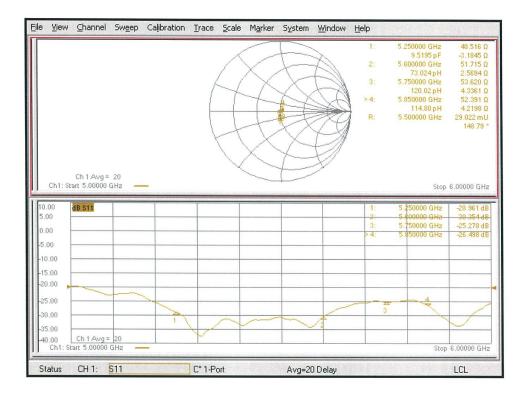
0 dB = 19.2 W/kg = 12.84 dBW/kg

Certificate No: D5GHzV2-1203\_Dec22

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## Impedance Measurement Plot for Head TSL



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# **ANNEX F: DAE4 Calibration Certificate (SN: 1317)**

#### Calibration Laboratory of

Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





Schweizerischer Kalibrierdienst Service suisse d'étalonnage 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

Client

Certificate No: DAE4-1317\_Sep23

bject	DAE4 - SD 000 DO	04 BM - SN: 1317	
alibration procedure(s)	QA CAL-06.v30 Calibration proced	lure for the data acquisition elect	eronics (DAE)
alibration date:	September 13, 2023		
alibration Equipment used (M&	TE critical for calibration)	facility: environment temperature (22 ± 3)°C  Cal Date (Certificate No.)	Scheduled Calibration
eithley Multimeter Type 2001	SN: 0810278	29-Aug-23 (No:37421)	Aug-24
econdary Standards	ID#	Check Date (in house)	Scheduled Check
uto DAE Calibration Unit		27-Jan-23 (in house check) 27-Jan-23 (in house check)	In house check: Jan-24 In house check: Jan-24
alibrator Box V2.1			
alibrator Box V2.1	Name	Function	Signature
alibrator Box V2.1	Name Dominique Steffen	Function Laboratory Technician	Signature
			Signature  2.V. S. Muller
alibrated by: pproved by:	Dominique Steffen Sven Kühn	Laboratory Technician	issued: September 13, 2023

Calibration Laboratory of

Schmid & Partner

Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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#### Glossary

DAE

data acquisition electronics

Connector angle

information used in DASY system to align probe sensor X to the robot

coordinate system.

#### Methods Applied and Interpretation of Parameters

- DC Voltage Measurement: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- Connector angle: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - DC Voltage Measurement Linearity: Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - Common mode sensitivity: Influence of a positive or negative common mode voltage on the differential measurement.
  - Channel separation: Influence of a voltage on the neighbor channels not subject to an input voltage.
  - AD Converter Values with inputs shorted: Values on the internal AD converter corresponding to zero input voltage
  - Input Offset Measurement: Output voltage and statistical results over a large number of zero voltage measurements.
  - Input Offset Current: Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - Input resistance: Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - Low Battery Alarm Voltage: Typical value for information. Below this voltage, a battery alarm signal is generated.
  - Power consumption: Typical value for information. Supply currents in various operating modes.

Certificate No: DAE4-1317\_Sep23

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# DC Voltage Measurement A/D - Converter Resolution nominal

full range = -100...+300 mV full range = -1......+3mV 6.1µV, High Range: Low Range: 1LSB = 61nV, DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	х	Y	Z
High Range	403.828 ± 0.02% (k=2)	404.593 ± 0.02% (k=2)	403.947 ± 0.02% (k=2)
Low Range	3.98059 ± 1.50% (k=2)	3.99254 ± 1.50% (k=2)	3.98124 ± 1.50% (k=2)

#### Connector Angle

Connector Angle to be used in DASY system	332.0 ° ± 1 °
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Certificate No: DAE4-1317\_Sep23

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# Appendix (Additional assessments outside the scope of SCS0108)

#### 1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	200035.87	-2.10	-0.00
Channel X + Input	20009.78	2.22	0.01
Channel X - Input	-20003.08	1.96	-0.01
Channel Y + Input	200038.43	1.12	0.00
Channel Y + Input	20007.38	0.01	0.00
Channel Y - Input	-20005.14	0.15	-0.00
Channel Z + Input	200035.44	-1.96	-0.00
Channel Z + Input	20007.06	-0.38	-0.00
Channel Z - Input	-20005.82	-0.50	0.00

Low Range	Reading (µV)	Difference (μV)	Error (%)
Channel X + Input	2002.30	-0.21	-0.01
Channel X + Input	202.91	0.62	0.31
Channel X - Input	-197.09	0.46	-0.24
Channel Y + Input	2001.50	-0.93	-0.05
Channel Y + Input	201.49	-0.69	-0.34
Channel Y - Input	-198.93	-1.28	0.65
Channel Z + Input	2002.15	-0.14	-0.01
Channel Z + Input	201.40	-0.60	-0.30
Channel Z - Input	-198.25	-0.54	0.27

#### 2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	12.18	10.32
	- 200	-9.53	-11.39
Channel Y	200	11.60	11.04
	- 200	-12.39	-13.28
Channel Z	200	1.85	2.16
	- 200	-3.72	-3.91

### 3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	1.45	-3.50
Channel Y	200	8.83		4.46
Channel Z	200	10.22	5.65	-

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4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15750	15569
Channel Y	16504	16920
Channel Z	16070	16718

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec Input  $10 M\Omega$ 

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (µV)
Channel X	0.33	-0.60	1.20	0.43
Channel Y	-0.09	-1.84	1.39	0.59
Channel Z	0.28	-0.95	2.09	0.54

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)	
Supply (+ Vcc)	+7.9	
Supply (- Vcc)	-7.6	

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9

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# **ANNEX G: The EUT Appearance**

The EUT Appearance are submitted separately.

# **ANNEX H: Test Setup Photos**

The Test Setup Photos are submitted separately.

\*\*\*\*\*END OF REPORT \*\*\*\*\*