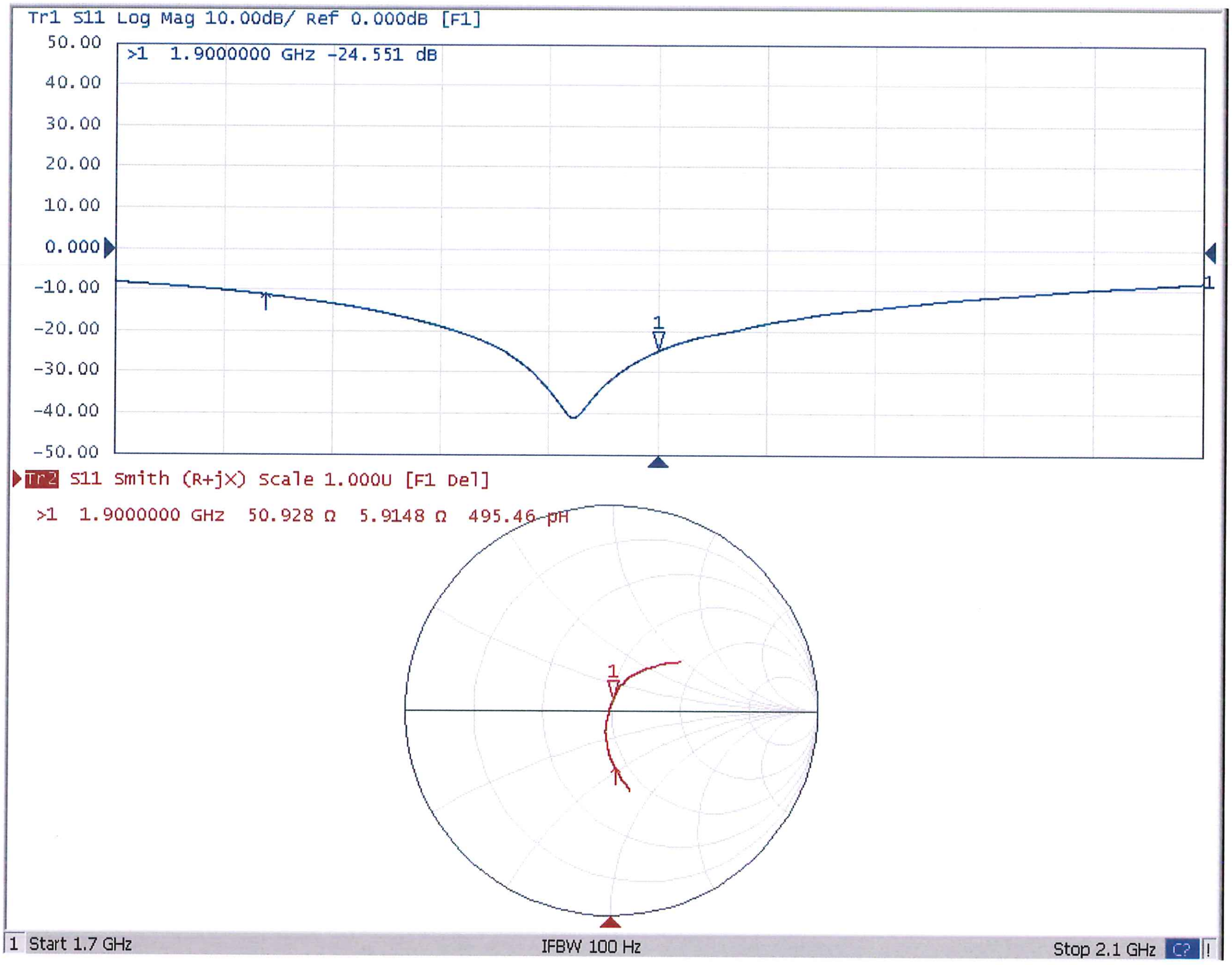
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



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E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Body TSL Date: 06.11.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d208

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1900 MHz; $\sigma = 1.499$ S/m; $\varepsilon_r = 52.18$; $\rho = 1000$ kg/m3

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(7.53, 7.53, 7.53) @ 1900 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

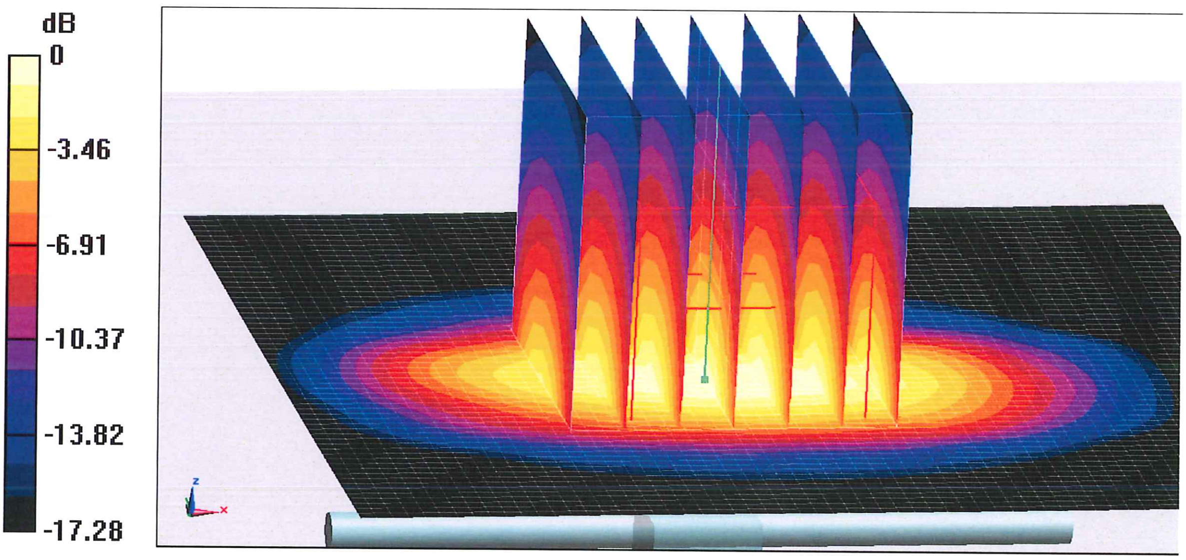
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.17 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 18.9 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.25 W/kg

Maximum value of SAR (measured) = 15.6 W/kg



0 dB = 15.6 W/kg = 11.93 dBW/kg

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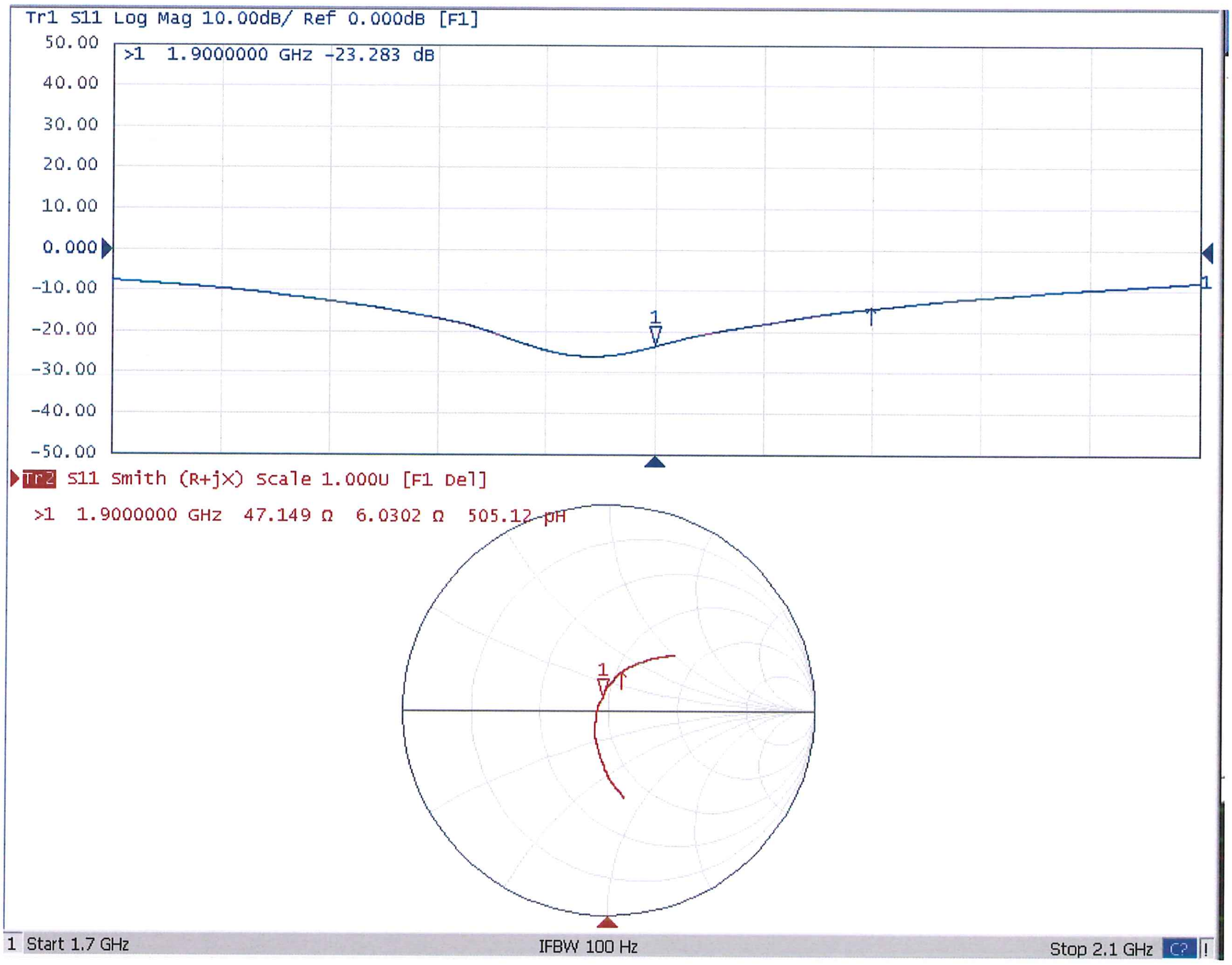
Impedance Measurement Plot for Body TSL



Dipole Internal Calibration Record

Asset No. :	E-431	Model No. :	D1900V2	Serial No. :	5d208
Environmental	23.5℃, 55 %	Original Cal. Date :	June 11, 2019	Next Cal. Date :	June 11, 2022

Standard List

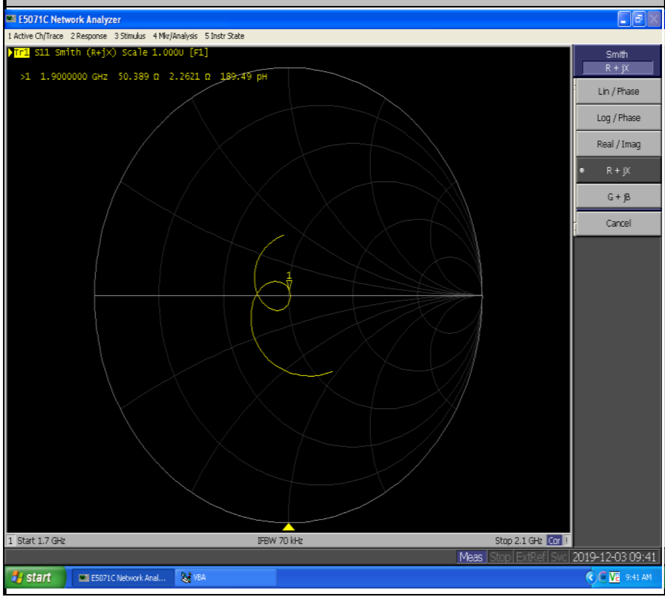
1	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorpiton Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Texhniques, June 2013
2	IEC 62209-2	Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body(frequency range of 30 MHz to 6 GHz), March 2010
3	KDB865664	SAR Measurement Requirements for 100 MHz to 6 GHz

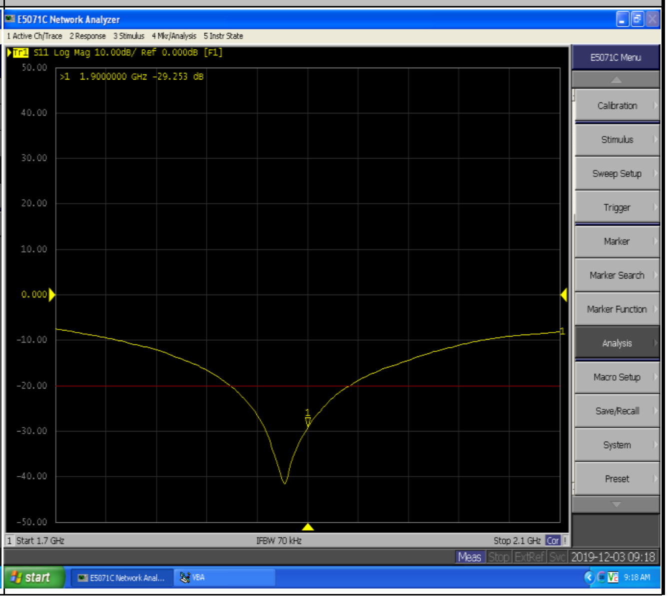
Equipment Information

Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZHL-42W+	QA1333003	NA	February 25, 2019
DC Source	Iteck	OT6154	M00157	NA	August 3, 2019
P-series power meter	Agilent	N1911A	MY45100473	NA	September 23, 2019
wideband power	Agilent	N1921A	MY51100041	NA	September 23, 2019
Smart Power Sensor	R&S	NRP-Z21	102209	NA	March 1, 2019
Dual directional	Woken	TS-PCC0M-05	107090019	NA	March 10, 2019
Signal Generator	Agilent	E4438C	MY4907131	NA	Mar. 10, 2019
ENA Network Analyzer	Agilent	E5071C	MY46102965	NA	March 10, 2019

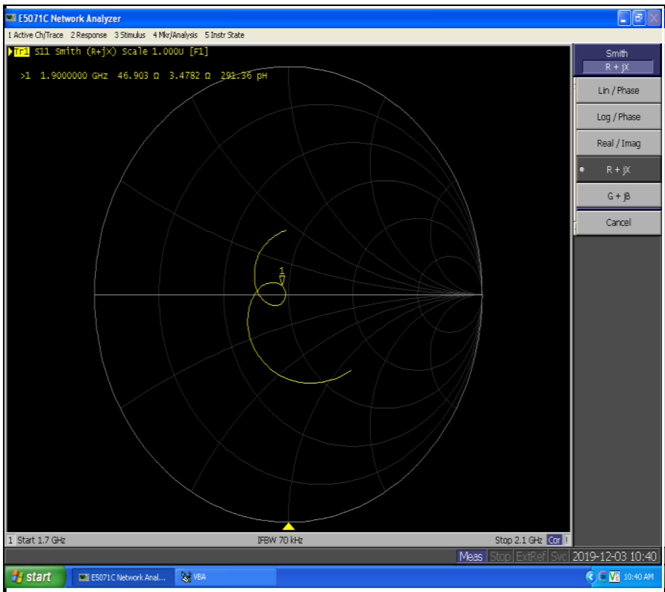
Model No	For Head Tissue				
	Item	Originak Cal. Result	Verified on 2019/12/3	Deviation	Result
D1900V2	Impedance, transformed to feed	50.9Ω+5.91jΩ	50.389Ω+2.26jΩ	<5Ω	Pass
	Return Loss(dB)	-24.6	-29.253	18.9%	Pass
	SAR Value for 1g(mW/g)	9.96	9.46	-5.0%	Pass
	SAR Value for 10g(mW/g)	5.21	4.95	-5.0%	Pass
	For Body Tissue				
	Item	Originak Cal. Result	Verified on 2019/12/3	Deviation	Result
	Impedance, transformed to feed	47.1Ω+6.03jΩ	46.903Ω+3.48jΩ	<5Ω	Pass
	Return Loss(dB)	-23.3	-26.162	12.3%	Pass
	SAR Value for 1g(mW/g)	10.2	10.3	1.0%	Pass
	SAR Value for 10g(mW/g)	5.29	5.35	1.1%	Pass

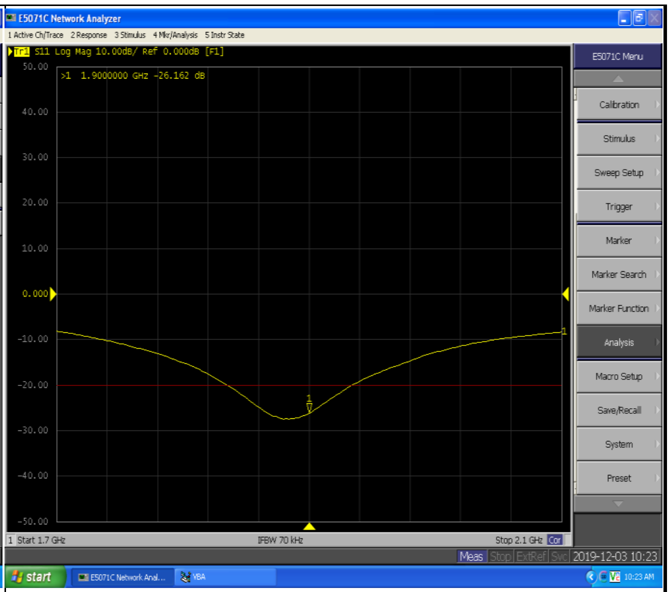
Impedance Test-Head	Return Loss-Head





Impedance Test-Body	Return Loss-Body





Validation Report for Head TSL

Test Laboratory: BTL Inc. Date: 2019/12/03

System Check_H1900_1203

DUT: Dipole 1900 MHz D1900V2;SN:5d179;

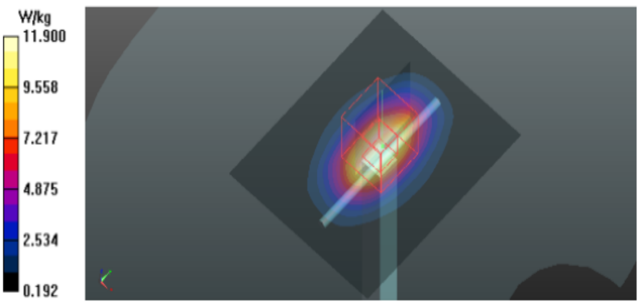
Communication System: UID 0, CW (0); Frequency: 1900 MHz; Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.379 S/m; ε_r = 39.603; ρ = 1000 kg/m^3
Ambient Temperature：23.2 ℃; Liquid Temperature：22.4 ℃

DASY Configuration:

- Probe: EX3DV4 - SN7544; ConvF(8.26, 8.26, 8.26) @ 1900 MHz; Calibrated: 2019/9/9
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1390; Calibrated: 2019/10/29
- Phantom: SAM Front; Type: Twin SAM; Serial: 1784
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (6x7x1): Interpolated grid: dx=15 mm, dy=15 mm
Maximum value of SAR (interpolated) = 13.3 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 108.8 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 17.0 W/kg
SAR(1 g) = 9.46 W/kg; SAR(10 g) = 4.95 W/kg
Maximum value of SAR (measured) = 11.9 W/kg



Validation Report for Body TSL

Test Laboratory: BTL Inc. Date: 2019/12/03

System Check_B1900_1203

DUT: Dipole 1900 MHz D1900V2;SN:5d179;

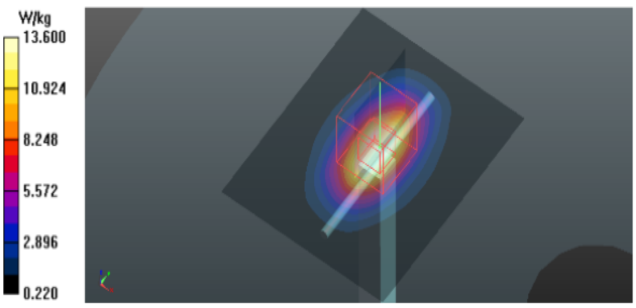
Communication System: UID 0, CW (0); Frequency: 1900 MHz; Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.513 S/m; ε_r = 51.305; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.2 ℃

DASY Configuration:

- Probe: EX3DV4 - SN7544; ConvF(7.9, 7.9, 7.9) @ 1900 MHz; Calibrated: 2019/9/9
- Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1390; Calibrated: 2019/10/29
- Phantom: SAM Front; Type: Twin SAM; Serial: 1784
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (6x7x1): Interpolated grid: dx=15 mm, dy=15 mm
Maximum value of SAR (interpolated) = 15.2 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 111.0 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 19.3 W/kg
SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.35 W/kg
Maximum value of SAR (measured) = 13.6 W/kg



Calibrator: Rot . Liang

Approver: Herbort Lin

Schmid & Partner Engineering AG

s p e a g

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IMPORTANT NOTICE

USAGE OF THE DAE4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is fixed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

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**
Swiss Calibration Service

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

Accreditation No.: SCS 0108

Client **BTL-TW (Auden)**

Certificate No: DAE4-1486_Jun21

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 1486
Calibration procedure(s)	QA CAL-06.v30 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	June 01, 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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	07-Sep-20 (No:28647)	Sep-21

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-21 (in house check)	In house check: Jan-22
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-21 (in house check)	In house check: Jan-22

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	i.V.

Issued: June 1, 2021

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.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

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

Calibration Factors	X	Y	Z
High Range	403.910 ± 0.02% (k=2)	403.983 ± 0.02% (k=2)	403.701 ± 0.02% (k=2)
Low Range	3.97965 ± 1.50% (k=2)	3.98992 ± 1.50% (k=2)	3.96014 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	33.0 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	200036.06	1.75	0.00
Channel X	+ Input	20006.04	0.25	0.00
Channel X	- Input	-20003.66	2.22	-0.01
Channel Y	+ Input	200035.62	1.23	0.00
Channel Y	+ Input	20004.43	-1.22	-0.01
Channel Y	- Input	-20003.19	2.83	-0.01
Channel Z	+ Input	200034.82	0.61	0.00
Channel Z	+ Input	20004.03	-1.64	-0.01
Channel Z	- Input	-20005.93	0.14	-0.00

Low Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	2001.34	-0.02	-0.00
Channel X	+ Input	201.18	-0.25	-0.12
Channel X	- Input	-198.88	-0.27	0.14
Channel Y	+ Input	2001.29	0.16	0.01
Channel Y	+ Input	200.40	-0.81	-0.40
Channel Y	- Input	-199.75	-0.96	0.48
Channel Z	+ Input	2000.91	-0.31	-0.02
Channel Z	+ Input	200.19	-1.07	-0.53
Channel Z	- Input	-199.55	-0.75	0.38

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	-0.73	-2.72
	- 200	3.23	1.45
Channel Y	200	-20.61	-21.28
	- 200	20.19	19.66
Channel Z	200	-4.08	-4.12
	- 200	2.93	2.63

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	-	-1.81	-3.55
Channel Y	200	6.76	-	1.65
Channel Z	200	10.99	3.37	-