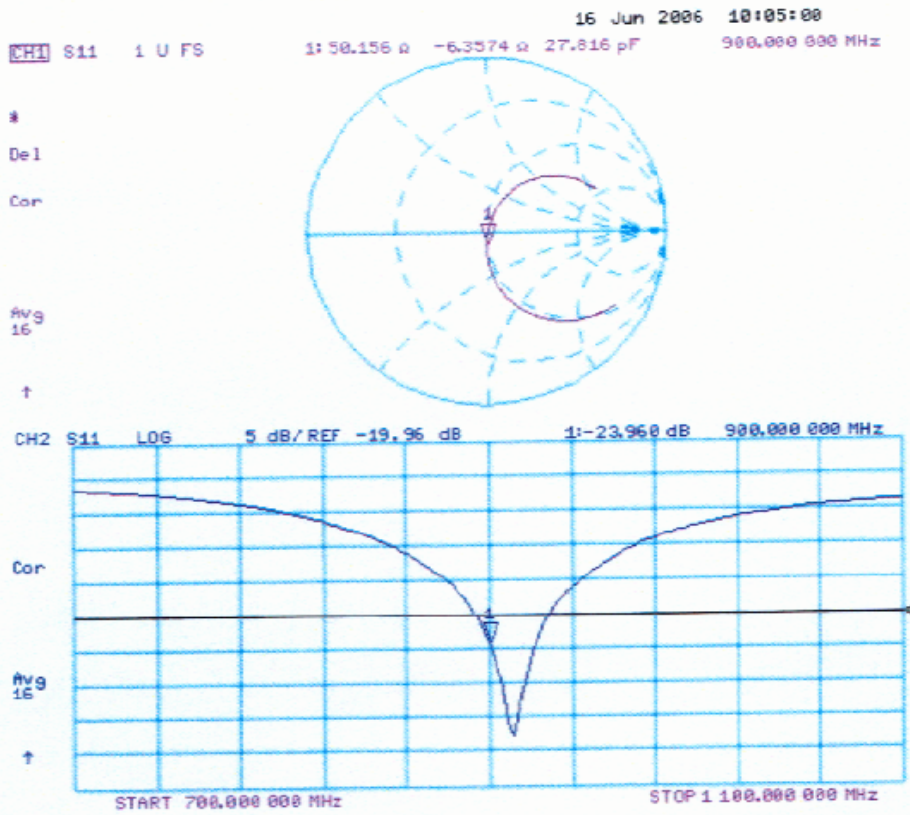


Impedance Measurement Plot for Head TSL



APPENDIX D – DAE3 CALIBRATION CERTIFICATES

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

Accredited by the Swiss Federal Office of Metrology and Accreditation
 The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **BACL**

Certificate No: **DAE3-456_Nov06**

CALIBRATION CERTIFICATE

Object: **DAE3 - SD 000 D03 AA - SN: 456**

Calibration procedure(s): **QA CAL-06.v12
 Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **November 22, 2006**

Condition of the calibrated item: **In Tolerance**

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Fluke Process Calibrator Type 702	SN: 6295803	13-Oct-06 (Eical AG, No: 5492)	Oct-07
Keithley Multimeter Type 2001	SN: 0810278	03-Oct-06 (Eical AG, No: 5478)	Oct-07
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1002	15-Jun-06 (SPEAG, in house check)	In house check Jun-07

Calibrated by: **Name: Eric Hairfeld, Function: Technician, Signature: [Signature]**

Approved by: **Name: Fin Bomholt, Function: R&D Director, Signature: [Signature]**

Issued: November 22, 2006

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

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



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Accreditation No.: **SCS 108**

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 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:* 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 = 6.1 μ V , 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	404.439 \pm 0.1% (k=2)	403.906 \pm 0.1% (k=2)	403.969 \pm 0.1% (k=2)
Low Range	3.93438 \pm 0.7% (k=2)	3.91686 \pm 0.7% (k=2)	3.94495 \pm 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	146 $^{\circ}$ \pm 1 $^{\circ}$
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Appendix

1. DC Voltage Linearity

High Range	Input (μV)	Reading (μV)	Error (%)
Channel X + Input	200000	200000	0.00
Channel X + Input	20000	20006.42	0.03
Channel X - Input	20000	-20005.03	0.03
Channel Y + Input	200000	199999.6	0.00
Channel Y + Input	20000	20004.36	0.02
Channel Y - Input	20000	-20008.05	0.04
Channel Z + Input	200000	199999.8	0.00
Channel Z + Input	20000	20005.63	0.03
Channel Z - Input	20000	-20006.88	0.03

Low Range	Input (μV)	Reading (μV)	Error (%)
Channel X + Input	2000	2000.1	0.00
Channel X + Input	200	200.25	0.13
Channel X - Input	200	-200.34	0.17
Channel Y + Input	2000	2000.1	0.00
Channel Y + Input	200	199.41	-0.30
Channel Y - Input	200	-200.64	0.32
Channel Z + Input	2000	2000.1	0.00
Channel Z + Input	200	199.56	-0.22
Channel Z - Input	200	-200.99	0.50

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	-3.41	-4.27
	-200	4.45	4.86
Channel Y	200	-7.35	-6.80
	-200	5.01	5.93
Channel Z	200	9.73	10.44
	-200	-12.17	-11.92

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	-	-0.13	-2.47
Channel Y	200	0.11	-	1.24
Channel Z	200	-1.80	-0.38	-