



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

Certificate No: **DAE4-658_Mar05****CALIBRATION CERTIFICATE**Object **DAE4 - SD 000 D04 BA - SN: 658**Calibration procedure(s) **QA CAL-06.v10**
Calibration procedure for the data acquisition unit (DAE)Calibration date: **March 30, 2005**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 $(22 \pm 3)^{\circ}\text{C}$ 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	7-Sep-04 (Sintrel, No.E-040073)	Sep-05
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1002	16-Jul-04 (SPEAG, in house check)	In house check Jul-05

Calibrated by:	Name	Function	Signature
	Eric Hainfeld	Technician	
Approved by:	Name	Function	Signature
	Fin Bornholt	R&D Director	

Issued: March 30, 2005

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

Certificate No: DAE4-658_Mar05

Page 1 of 5



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**

Glossary

DAE digital 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	404.903 $\pm$ 0.1% (k=2)	405.558 $\pm$ 0.1% (k=2)	404.679 $\pm$ 0.1% (k=2)
Low Range	3.95385 $\pm$ 0.7% (k=2)	3.97596 $\pm$ 0.7% (k=2)	3.92396 $\pm$ 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	11 $^{\circ}$ $\pm$ 1 $^{\circ}$
---	----------------------------------

**Appendix****1. DC Voltage Linearity**

High Range	Input (μV)	Reading (μV)	Error (%)
Channel X + Input	200000	200000.1	0.00
Channel X + Input	20000	20002.73	0.01
Channel X - Input	20000	-19994.94	-0.03
Channel Y + Input	200000	200000.4	0.00
Channel Y + Input	20000	19999.59	0.00
Channel Y - Input	20000	-19995.52	-0.02
Channel Z + Input	200000	200000.2	0.00
Channel Z + Input	20000	20000.11	0.00
Channel Z - Input	20000	-19998.59	-0.01

Low Range	Input (μV)	Reading (μV)	Error (%)
Channel X + Input	2000	2000	0.00
Channel X + Input	200	200.34	0.17
Channel X - Input	200	-200.17	0.08
Channel Y + Input	2000	2000.1	0.00
Channel Y + Input	200	199.33	-0.33
Channel Y - Input	200	-200.68	0.34
Channel Z + Input	2000	1999.9	0.00
Channel Z + Input	200	199.24	-0.38
Channel Z - Input	200	-201.01	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	-13.88	-15.94
	- 200	16.64	16.19
Channel Y	200	-15.73	-16.74
	- 200	14.95	15.21
Channel Z	200	-8.70	-10.46
	- 200	8.55	8.69

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	-	2.67	0.07
Channel Y	200	0.58	-	3.05
Channel Z	200	-1.84	0.66	-

**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	16059	16215
Channel Y	15676	15942
Channel Z	15471	15731

5. Input Offset Measurement

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

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	0.63	-1.23	2.00	0.38
Channel Y	-0.97	-2.83	0.94	0.46
Channel Z	-0.41	-2.34	0.55	0.40

6. Input Offset Current

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

7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.1999	198.3
Channel Y	0.2000	199.9
Channel Z	0.2000	199.7

8. Low Battery Alarm Voltage (verified during pre test)

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

9. Power Consumption (verified during pre test)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.0	+6	+14
Supply (- Vcc)	-0.01	-8	-9

10. Common Mode Bit Generation (verified during pre test)

Typical values	Bit set to High at Common Mode Error (V _{DC})
Channel X, Y, Z	+1.25