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Accreditation No.: **SCS 0108**

Client **Auden**

Certificate No: **DAE4-679\_Jun16**

## CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BM - SN: 679**

Calibration procedure(s) **QA CAL-06.v29  
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **June 13, 2016**

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	09-Sep-15 (No:17153)	Sep-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-16 (in house check)	In house check: Jan-17
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-16 (in house check)	In house check: Jan-17

Calibrated by:	Name Dominique Steffen	Function Technician	Signature 
Approved by:	Fin Bornholt	Deputy Technical Manager	

Issued: June 13, 2016

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Accreditation No.: **SCS 0108**

## 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 = 6.1 $\mu$ 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	404.367 $\pm$ 0.02% (k=2)	404.846 $\pm$ 0.02% (k=2)	404.897 $\pm$ 0.02% (k=2)
Low Range	3.96978 $\pm$ 1.50% (k=2)	3.95628 $\pm$ 1.50% (k=2)	3.96167 $\pm$ 1.50% (k=2)

## Connector Angle

Connector Angle to be used in DASY system	292.5 $^{\circ}$ $\pm$ 1 $^{\circ}$
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## Appendix (Additional assessments outside the scope of SCS0108)

### 1. DC Voltage Linearity

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	199999.89	4.32	0.00
Channel X + Input	20004.79	3.20	0.02
Channel X - Input	-19997.83	2.62	-0.01
Channel Y + Input	200000.30	4.81	0.00
Channel Y + Input	20003.39	1.96	0.01
Channel Y - Input	-20000.30	0.23	-0.00
Channel Z + Input	199996.45	0.91	0.00
Channel Z + Input	20000.13	-1.30	-0.01
Channel Z - Input	-20001.47	-0.67	0.00

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2002.81	1.49	0.07
Channel X + Input	202.44	0.57	0.28
Channel X - Input	-197.34	0.73	-0.37
Channel Y + Input	2002.06	0.73	0.04
Channel Y + Input	202.62	0.90	0.45
Channel Y - Input	-198.41	-0.31	0.16
Channel Z + Input	2000.75	-0.45	-0.02
Channel Z + Input	201.64	-0.04	-0.02
Channel Z - Input	-199.13	-0.90	0.46

### 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 ( $\mu\text{V}$ )	Low Range Average Reading ( $\mu\text{V}$ )
Channel X	200	4.69	3.62
	- 200	-1.22	-2.72
Channel Y	200	5.25	5.14
	- 200	-4.96	-5.39
Channel Z	200	-3.80	-4.43
	- 200	1.97	1.58

### 3. Channel separation

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

	Input Voltage (mV)	Channel X ( $\mu\text{V}$ )	Channel Y ( $\mu\text{V}$ )	Channel Z ( $\mu\text{V}$ )
Channel X	200	-	-0.39	-2.04
Channel Y	200	7.70	-	-0.17
Channel Z	200	7.19	5.46	-

#### 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	16168	16943
Channel Y	15459	17452
Channel Z	16058	16102

#### 5. Input Offset Measurement

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

Input 10M $\Omega$

	Average ( $\mu$ V)	min. Offset ( $\mu$ V)	max. Offset ( $\mu$ V)	Std. Deviation ( $\mu$ V)
Channel X	0.09	-1.13	2.10	0.48
Channel Y	-0.14	-1.97	1.85	0.74
Channel Z	-0.95	-2.03	0.11	0.49

#### 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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Client : **Sporton**

Certificate No: **Z16-97185**

## CALIBRATION CERTIFICATE

Object **DAE4 - SN: 1388**

Calibration Procedure(s) **FD-Z11-002-01**  
 Calibration Procedure for the Data Acquisition Electronics (DAEx)

Calibration date: **October 10, 2016**

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
Process Calibrator 753	1971018	27-June-16 (CTTL, No:J16X04778)	June-17

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued October 11, 2016

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**CALIBRATION LABORATORY**

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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 report provide only calibration results for DAE, it does not contain other performance test results.



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**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	403.527 ± 0.15% (k=2)	403.425 ± 0.15% (k=2)	403.211 ± 0.15% (k=2)
Low Range	3.97413 ± 0.7% (k=2)	3.98786 ± 0.7% (k=2)	3.99357 ± 0.7% (k=2)

**Connector Angle**

Connector Angle to be used in DASY system	155° ± 1 °
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Client **Sporton - TW (Auden)**

Certificate No: **DAE3-495\_May16**

## CALIBRATION CERTIFICATE

Object **DAE3 - SD 000 D03 AD - SN: 495**

Calibration procedure(s) **QA CAL-06.v29  
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **May 27, 2016**

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 ( $22 \pm 3$ )°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	09-Sep-15 (No:17153)	Sep-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-16 (in house check)	In house check: Jan-17
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-16 (in house check)	In house check: Jan-17

	Name	Function	Signature
Calibrated by:	R.Mayoraz	Technician	
Approved by:	Fin Bornholt	Deputy Technical Manager	

Issued: May 27, 2016

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Accreditation No.: **SCS 0108**

## 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 = 6.1 $\mu$ 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	404.392 $\pm$ 0.02% (k=2)	405.369 $\pm$ 0.02% (k=2)	405.725 $\pm$ 0.02% (k=2)
Low Range	3.95295 $\pm$ 1.50% (k=2)	3.99096 $\pm$ 1.50% (k=2)	3.96580 $\pm$ 1.50% (k=2)

## Connector Angle

Connector Angle to be used in DASY system	78.0 $^{\circ}$ $\pm$ 1 $^{\circ}$
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## Appendix (Additional assessments outside the scope of SCS0108)

### 1. DC Voltage Linearity

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	199996.62	1.58	0.00
Channel X + Input	20000.74	-0.12	-0.00
Channel X - Input	-19996.44	4.68	-0.02
Channel Y + Input	199995.94	1.53	0.00
Channel Y + Input	20002.54	1.56	0.01
Channel Y - Input	-19999.75	1.29	-0.01
Channel Z + Input	199992.83	-1.82	-0.00
Channel Z + Input	20002.61	1.74	0.01
Channel Z - Input	-19998.46	2.69	-0.01

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2001.48	0.75	0.04
Channel X + Input	201.55	0.46	0.23
Channel X - Input	-198.32	0.30	-0.15
Channel Y + Input	2000.13	-0.57	-0.03
Channel Y + Input	200.91	-0.45	-0.22
Channel Y - Input	-199.30	-0.77	0.39
Channel Z + Input	1999.63	-0.96	-0.05
Channel Z + Input	200.82	-0.44	-0.22
Channel Z - Input	-199.88	-1.27	0.64

### 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 ( $\mu\text{V}$ )	Low Range Average Reading ( $\mu\text{V}$ )
Channel X	200	3.18	2.27
	- 200	-2.19	-3.80
Channel Y	200	0.69	0.05
	- 200	-0.39	-0.92
Channel Z	200	2.28	2.22
	- 200	-4.44	-4.68

### 3. Channel separation

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

	Input Voltage (mV)	Channel X ( $\mu\text{V}$ )	Channel Y ( $\mu\text{V}$ )	Channel Z ( $\mu\text{V}$ )
Channel X	200	-	-0.76	-2.16
Channel Y	200	7.44	-	-0.52
Channel Z	200	5.77	5.68	-

#### 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	15817	17431
Channel Y	15765	17509
Channel Z	15903	17029

#### 5. Input Offset Measurement

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

Input 10M $\Omega$

	Average ( $\mu$ V)	min. Offset ( $\mu$ V)	max. Offset ( $\mu$ V)	Std. Deviation ( $\mu$ V)
Channel X	-0.15	-1.92	1.72	0.56
Channel Y	0.33	-0.86	2.13	0.60
Channel Z	-1.62	-2.91	-0.07	0.62

#### 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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Accreditation No.: **SCS 0108**

Client **Sporton - TW (Auden)**

Certificate No: **DAE4-778\_May16**

## CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BM - SN: 778**

Calibration procedure(s) **QA CAL-06.v29**  
**Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **May 12, 2016**

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.

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Calibration Equipment used (M&TE critical for calibration)

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Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-16 (in house check)	In house check: Jan-17

Calibrated by:	Name Dominique Steffen	Function Technician	Signature 
Approved by:	Fin Bomholt	Deputy Technical Manager	

Issued: May 12, 2016

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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.

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  - *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 = 6.1 $\mu$ 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	404.712 $\pm$ 0.02% (k=2)	403.516 $\pm$ 0.02% (k=2)	405.068 $\pm$ 0.02% (k=2)
Low Range	3.98678 $\pm$ 1.50% (k=2)	3.96495 $\pm$ 1.50% (k=2)	4.00091 $\pm$ 1.50% (k=2)

## Connector Angle

Connector Angle to be used in DASY system	270.0 $\pm$ 1 $^{\circ}$
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## Appendix (Additional assessments outside the scope of SCS0108)

### 1. DC Voltage Linearity

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	200032.14	-1.38	-0.00
Channel X + Input	20005.68	0.79	0.00
Channel X - Input	-20003.61	1.31	-0.01
Channel Y + Input	200030.28	-3.73	-0.00
Channel Y + Input	20006.01	1.25	0.01
Channel Y - Input	-20003.00	1.89	-0.01
Channel Z + Input	200035.46	1.52	0.00
Channel Z + Input	20002.36	-2.31	-0.01
Channel Z - Input	-20008.31	-3.27	0.02

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2001.27	0.01	0.00
Channel X + Input	201.37	0.21	0.10
Channel X - Input	-198.61	-0.02	0.01
Channel Y + Input	2001.38	0.24	0.01
Channel Y + Input	200.13	-0.97	-0.48
Channel Y - Input	-198.84	-0.10	0.05
Channel Z + Input	2001.29	0.21	0.01
Channel Z + Input	200.34	-0.69	-0.34
Channel Z - Input	-200.58	-1.74	0.88

### 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 ( $\mu\text{V}$ )	Low Range Average Reading ( $\mu\text{V}$ )
Channel X	200	-4.35	-5.61
	- 200	7.07	5.78
Channel Y	200	-1.79	-1.82
	- 200	0.49	0.20
Channel Z	200	-12.55	-12.56
	- 200	10.17	10.19

### 3. Channel separation

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

	Input Voltage (mV)	Channel X ( $\mu\text{V}$ )	Channel Y ( $\mu\text{V}$ )	Channel Z ( $\mu\text{V}$ )
Channel X	200	-	-0.66	-2.54
Channel Y	200	8.70	-	-0.26
Channel Z	200	3.71	7.16	-

#### 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	16054	16869
Channel Y	16191	17846
Channel Z	16441	16314

#### 5. Input Offset Measurement

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

Input 10M $\Omega$

	Average ( $\mu$ V)	min. Offset ( $\mu$ V)	max. Offset ( $\mu$ V)	Std. Deviation ( $\mu$ V)
Channel X	0.48	-0.60	1.44	0.42
Channel Y	-0.09	-1.42	2.50	0.58
Channel Z	-1.11	-2.45	-0.19	0.45

#### 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