



APPENDIX E - MEASURED FLUID DIELECTRIC PARAMETERS

Title

SubTitle

September 14, 2015 03:39 PM

Frequency	e'	e''
2.400000000 GI	51.4270	14.3769
2.402000000 GI	51.4220	14.3766
2.404000000 GI	51.4230	14.4061
2.406000000 GI	51.4190	14.4125
2.408000000 GI	51.4180	14.4218
2.410000000 GI	51.4140	14.4348
2.412000000 GI	51.4070	14.4515
2.414000000 GI	51.4020	14.4510
2.416000000 GI	51.3950	14.4643
2.418000000 GI	51.4010	14.4695
2.420000000 GI	51.3860	14.4733
2.422000000 GI	51.3780	14.4765
2.424000000 GI	51.3760	14.4841
2.426000000 GI	51.3760	14.4814
2.428000000 GI	51.3740	14.4924
2.430000000 GI	51.3570	14.5031
2.432000000 GI	51.3570	14.5004
2.434000000 GI	51.3470	14.4953
2.436000000 GI	51.3360	14.4986
2.438000000 GI	51.3270	14.4968
2.440000000 GI	51.3300	14.5121
2.442000000 GI	51.3060	14.5135
2.444000000 GI	51.3010	14.4977
2.446000000 GI	51.3060	14.5044
2.448000000 GI	51.2940	14.5096
2.450000000 GI	51.2800	14.5099
2.452000000 GI	51.2770	14.5073
2.454000000 GI	51.2660	14.4921
2.456000000 GI	51.2640	14.4995
2.458000000 GI	51.2610	14.5053
2.460000000 GI	51.2420	14.5111
2.462000000 GI	51.2370	14.5036
2.464000000 GI	51.2140	14.4881
2.466000000 GI	51.2030	14.4963
2.468000000 GI	51.1830	14.5006

2.470000000 GI	51.177%	14.5049
2.472000000 GI	51.172%	14.5091
2.474000000 GI	51.166%	14.5035
2.476000000 GI	51.166%	14.5238
2.478000000 GI	51.147%	14.5196
2.480000000 GI	51.133%	14.5381
2.482000000 GI	51.124%	14.5511
2.484000000 GI	51.105%	14.5585
2.486000000 GI	51.106%	14.5703
2.488000000 GI	51.093%	14.5836
2.490000000 GI	51.084%	14.5899
2.492000000 GI	51.068%	14.6036
2.494000000 GI	51.063%	14.6128
2.496000000 GI	51.065%	14.6344
2.498000000 GI	51.046%	14.6450
2.500000000 GI	51.040%	14.6542



APPENDIX F – PHANTOM CERTIFICATE OF CONFORMITY

Certificate of conformity / First Article Inspection

Item	SAM Twin Phantom V4.0
Type No	QD 000 P40 C
Series No	TP-1150 and higher
Manufacturer / Origin	Untersee Composites Hauptstr. 69 CH-8559 Fruthwilen Switzerland

Tests

The series production process used allows the limitation to test of first articles.

Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series units (called samples).

Test	Requirement	Details	Units tested
Shape	Compliance with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness	Compliant with the requirements according to the standards	2mm +/- 0.2mm in specific areas; 6mm +/- 0.2mm at ERP	First article, Samples
Material parameters	Dielectric parameters for required frequencies	200 MHz – 3 GHz Relative permittivity < 5 Loss tangent < 0.05.	Material sample TP 104-5
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions	DEGMBE based simulating liquids	Pre-series, First article, Samples

Standards

[1] CENELEC EN 50361

[2] IEEE Std 1528-200x Draft CD 1.1 (Dec 02)

[3] IEC 62209/CD (Nov 02)

(*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

Date

7.8.2003

Signature / Stamp

s p e a g

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APPENDIX G - DAE CALIBRATION CERTIFICATE



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Client **MET Laboratories**

Certificate No: **DAE3-584_Oct14**

CALIBRATION CERTIFICATE

Object **DAE3 - SD 000 D03 AA - SN: 584**

Calibration procedure(s) **QA CAL-06.v28**
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: **October 14, 2014**

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 (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	03-Oct-14 (No:15573)	Oct-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-14 (in house check)	In house check: Jan-15
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-14 (in house check)	In house check: Jan-15

Calibrated by: **Name**
Dominique Steffen **Function**
Technician

Approved by: **Fin Bomholt** **Deputy Technical Manager**

Signature

Issued: October 14, 2014

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

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	16109	15608
Channel Y	16210	15968
Channel Z	16290	16554

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	1.05	-0.16	2.07	0.47
Channel Y	-0.22	-1.35	0.95	0.48
Channel Z	-0.26	-1.18	0.83	0.44

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

Appendix (Additional assessments outside the scope of SCS108)

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	199995.08	-1.66	-0.00
Channel X + Input	20002.21	1.08	0.01
Channel X - Input	-20000.68	0.02	-0.00
Channel Y + Input	199994.29	-2.51	-0.00
Channel Y + Input	20003.95	2.80	0.01
Channel Y - Input	-19993.87	6.83	-0.03
Channel Z + Input	199998.36	1.04	0.00
Channel Z + Input	19998.84	-2.32	-0.01
Channel Z - Input	-19998.87	1.78	-0.01

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2001.52	0.61	0.03
Channel X + Input	202.04	0.52	0.26
Channel X - Input	-199.11	-0.68	0.34
Channel Y + Input	2000.36	-0.59	-0.03
Channel Y + Input	200.66	-0.74	-0.37
Channel Y - Input	-198.89	-0.40	0.20
Channel Z + Input	2000.93	0.07	0.00
Channel Z + Input	200.48	-0.82	-0.41
Channel Z - Input	-199.35	-0.69	0.35

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	2.93	1.03
	- 200	-0.10	-2.11
Channel Y	200	2.28	2.64
	- 200	-4.13	-3.84
Channel Z	200	-6.31	-7.07
	- 200	4.44	4.48

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	-	-0.15	-4.15
Channel Y	200	6.74	-	-0.20
Channel Z	200	7.03	5.14	-

DC Voltage Measurement

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	404.637 \pm 0.02% (k=2)	404.822 \pm 0.02% (k=2)	404.252 \pm 0.02% (k=2)
Low Range	3.92983 \pm 1.50% (k=2)	3.91835 \pm 1.50% (k=2)	3.94518 \pm 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	141.0 $^{\circ}$ \pm 1 $^{\circ}$
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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 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.