



APPENDIX E - MEASURED FLUID DIELECTRIC PARAMETERS

Title

SubTitle

February 27, 2014 2:09 PM

Frequency	e'	e''
2.400000000 GHz	38.386	13.8136
2.402000000 GHz	38.376	13.8246
2.404000000 GHz	38.383	13.8389
2.406000000 GHz	38.372	13.8527
2.408000000 GHz	38.373	13.8625
2.410000000 GHz	38.368	13.8910
2.412000000 GHz	38.356	13.8946
2.414000000 GHz	38.347	13.9055
2.416000000 GHz	38.349	13.9254
2.418000000 GHz	38.344	13.9321
2.420000000 GHz	38.335	13.9404
2.422000000 GHz	38.324	13.9360
2.424000000 GHz	38.320	13.9386
2.426000000 GHz	38.305	13.9566
2.428000000 GHz	38.306	13.9560
2.430000000 GHz	38.291	13.9624
2.432000000 GHz	38.292	13.9694
2.434000000 GHz	38.277	13.9591
2.436000000 GHz	38.260	13.9490
2.438000000 GHz	38.254	13.9530
2.440000000 GHz	38.248	13.9494
2.442000000 GHz	38.231	13.9444
2.444000000 GHz	38.231	13.9503
2.446000000 GHz	38.216	13.9490
2.448000000 GHz	38.210	13.9518
2.450000000 GHz	38.200	13.9434
2.452000000 GHz	38.191	13.9465
2.454000000 GHz	38.184	13.9403
2.456000000 GHz	38.179	13.9468
2.458000000 GHz	38.174	13.9392
2.460000000 GHz	38.148	13.9431
2.462000000 GHz	38.145	13.9416
2.464000000 GHz	38.132	13.9414
2.466000000 GHz	38.135	13.9468
2.468000000 GHz	38.123	13.9502

2.470000000 Gf	38.102f	13.9510
2.472000000 Gf	38.101f	13.9556
2.474000000 Gf	38.081f	13.9728
2.476000000 Gf	38.070f	13.9697
2.478000000 Gf	38.068f	13.9758
2.480000000 Gf	38.049f	13.9840
2.482000000 Gf	38.038f	13.9809
2.484000000 Gf	38.026f	13.9882
2.486000000 Gf	38.022f	14.0060
2.488000000 Gf	38.007f	14.0201
2.490000000 Gf	38.003f	14.0288
2.492000000 Gf	37.988f	14.0364
2.494000000 Gf	37.982f	14.0455
2.496000000 Gf	37.963f	14.0473
2.498000000 Gf	37.961f	14.0622
2.500000000 Gf	37.956f	14.0749



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

Schmid & Partner Engineering AG
 Zeughausstrasse 43, 8004 Zurich, Switzerland
 Phone +41 1 245 9700, Fax +41 1 245 9779
 info@speag.com, http://www.speag.com



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_Jul13**

CALIBRATION CERTIFICATE

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

Calibration procedure(s) **QA CAL-06.v26**
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: **July 18, 2013**

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	02-Oct-12 (No:12728)	Oct-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-13 (in house check)	In house check: Jan-14
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-13 (in house check)	In house check: Jan-14

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

Issued: July 18, 2013

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



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 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.

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	404.662 $\pm$ 0.02% (k=2)	404.844 $\pm$ 0.02% (k=2)	404.267 $\pm$ 0.02% (k=2)
Low Range	3.93273 $\pm$ 1.50% (k=2)	3.98110 $\pm$ 1.50% (k=2)	3.97938 $\pm$ 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	141.0 ° $\pm$ 1 °
---	-------------------

Appendix

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	199996.51	-1.40	-0.00
Channel X + Input	20001.72	1.16	0.01
Channel X - Input	-19998.74	2.23	-0.01
Channel Y + Input	199995.49	-2.08	-0.00
Channel Y + Input	20001.55	1.15	0.01
Channel Y - Input	-19997.38	3.75	-0.02
Channel Z + Input	199996.10	-1.20	-0.00
Channel Z + Input	19999.08	-1.38	-0.01
Channel Z - Input	-19999.72	1.40	-0.01

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2002.82	1.92	0.10
Channel X + Input	202.17	0.93	0.46
Channel X - Input	-198.65	-0.18	0.09
Channel Y + Input	2002.22	1.54	0.08
Channel Y + Input	200.42	-0.71	-0.35
Channel Y - Input	-199.73	-1.09	0.55
Channel Z + Input	2000.94	0.28	0.01
Channel Z + Input	200.01	-1.13	-0.56
Channel Z - Input	-200.29	-1.60	0.80

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	3.04	1.31
	- 200	-0.45	-1.35
Channel Y	200	3.69	2.42
	- 200	-3.59	-3.54
Channel Z	200	-7.37	-7.51
	- 200	5.30	5.09

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	-	-0.18	-3.67
Channel Y	200	6.93	-	-0.17
Channel Z	200	7.39	5.46	-

IMPORTANT NOTICE

USAGE OF THE DAE 3

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 DAE3 unit is connected to a fragile 3-pin battery connector. Customer is responsible to apply outmost caution not to bend or damage the connector when changing batteries.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration the customer shall 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 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, 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.

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	15852
Channel Y	16158	16754
Channel Z	16279	16611

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	1.30	-0.50	3.30	0.53
Channel Y	-0.18	-1.65	1.35	0.50
Channel Z	-0.26	-1.48	1.14	0.47

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