



ET3DV6 SN:1787

May 31, 2006

Probe ET3DV6

SN:1787

Manufactured:	May 28, 2003
Last calibrated:	August 29, 2003
Recalibrated:	May 31, 2006

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)



ET3DV6 SN:1787

May 31, 2006

DASY - Parameters of Probe: ET3DV6 SN:1787

Sensitivity in Free Space^A

Diode Compression^B

NormX	1.57 ± 10.1%	$\mu V/(V/m)^2$	DCP X	94 mV
NormY	1.71 ± 10.1%	$\mu V/(V/m)^2$	DCP Y	94 mV
NormZ	2.09 ± 10.1%	$\mu V/(V/m)^2$	DCP Z	94 mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL 900 MHz Typical SAR gradient: 5 % per mm

Sensor Center to Phantom Surface Distance		3.7 mm	4.7 mm
SAR _{tb} [%]	Without Correction Algorithm	7.2	3.8
SAR _{tb} [%]	With Correction Algorithm	0.0	0.2

TSL 1810 MHz Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance		3.7 mm	4.7 mm
SAR _{tb} [%]	Without Correction Algorithm	6.3	3.6
SAR _{tb} [%]	With Correction Algorithm	0.1	0.3

Sensor Offset

Probe Tip to Sensor Center 2.7 mm

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 8).

^B Numerical linearization parameter: uncertainty not required.

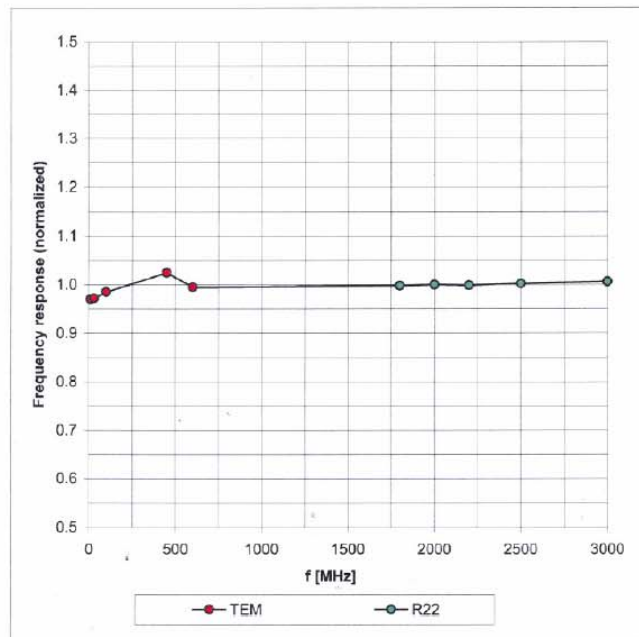


ET3DV6 SN:1787

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Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide: R22)



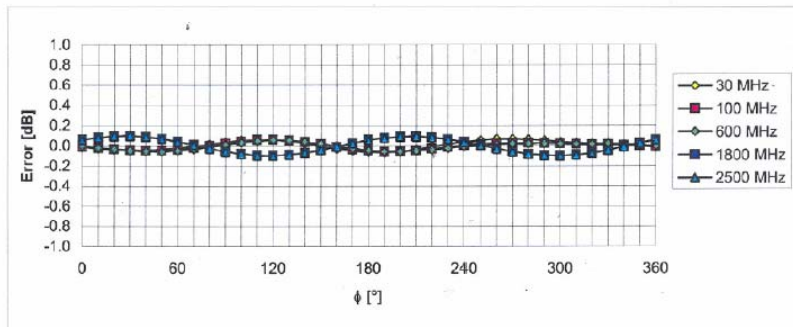
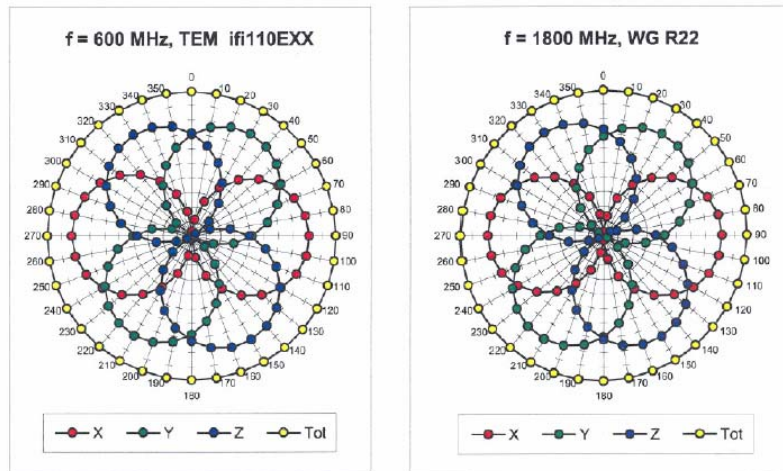
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)



ET3DV6 SN:1787

May 31, 2006

Receiving Pattern (ϕ), $\theta = 0^\circ$



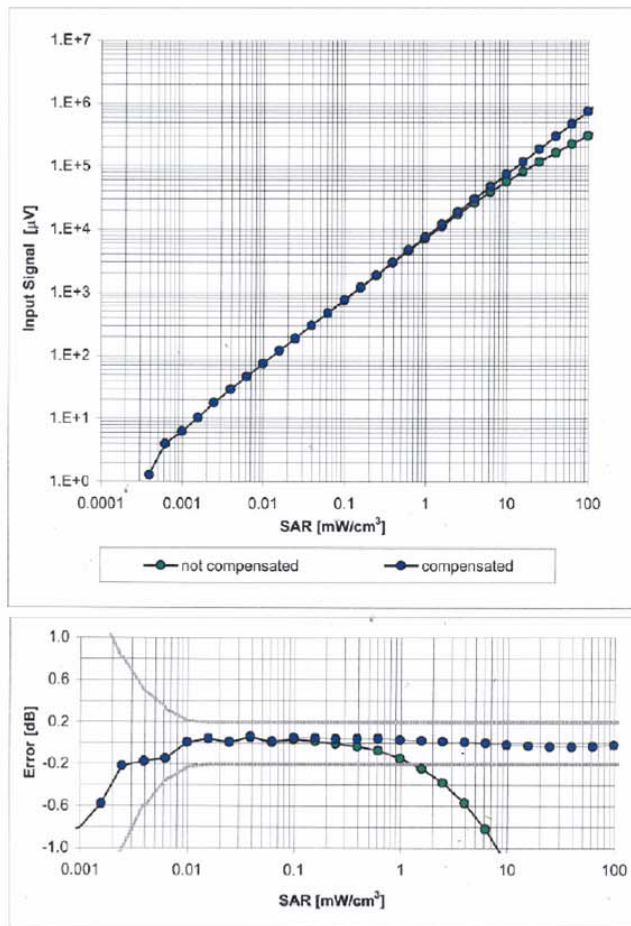
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)



ET3DV6 SN:1787

May 31, 2006

Dynamic Range f(SAR_{head}) (Waveguide R22, f = 1800 MHz)



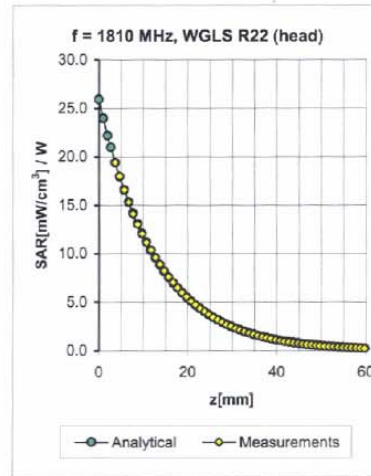
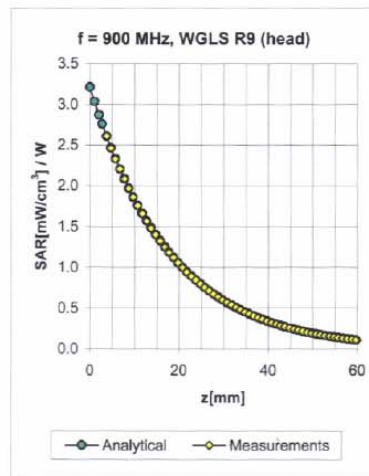
Uncertainty of Linearity Assessment: ± 0.6% (k=2)



ET3DV6 SN:1787

May 31, 2006

Conversion Factor Assessment



f [MHz]	Validity [MHz] ^c	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.50	1.85	6.38 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.59	2.46	5.26 ± 11.0% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.44	2.10	6.18 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.62	2.44	4.66 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.62	2.13	4.13 ± 11.8% (k=2)

^c The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

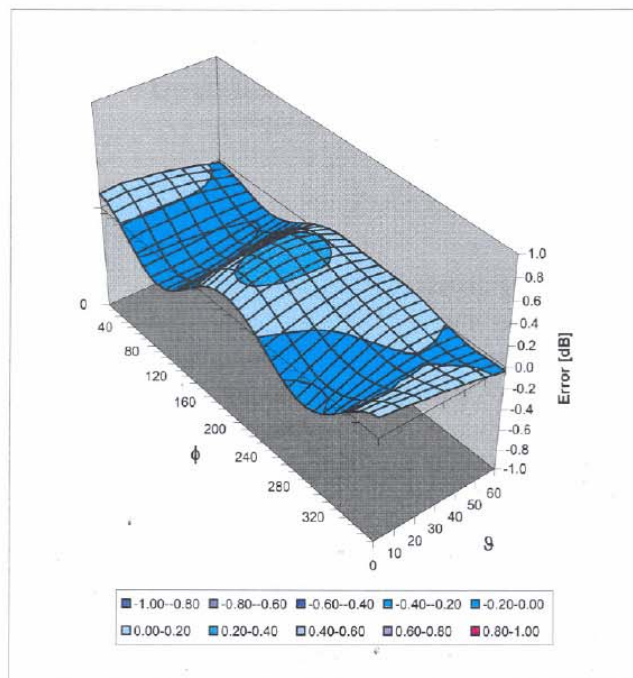


ET3DV6 SN:1787

May 31, 2006

Deviation from Isotropy in HSL

Error (ϕ , θ), $f = 900$ MHz



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)



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Accreditation No.: SCS 108

Client (Auden)

Certificate No: EX3-3578_Mar06

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3578
Calibration procedure(s): QA CAL-01.v5 and QA CAL-14.v3
Calibration date: March 20, 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).

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)

Table with 4 columns: Primary Standards, ID #, Cal Date (Calibrated by, Certificate No.), Scheduled Calibration. Lists various power meters, sensors, attenuators, and probes.

Table with 4 columns: Secondary Standards, ID #, Check Date (in house), Scheduled Check. Lists RF generator and Network Analyzer.

Calibrated by: Katja Pokovic, Technical Manager
Approved by: Fin Bornholt, R&D Director

Issued: March 22, 2006

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



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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001

Methods Applied and Interpretation of Parameters:

- *NORM_{x,y,z}*: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). *NORM_{x,y,z}* are only intermediate values, i.e., the uncertainties of *NORM_{x,y,z}* does not effect the E^2 -field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)_{x,y,z}* = *NORM_{x,y,z}* * *frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCP_{x,y,z}*: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- *ConvF and Boundary Effect Parameters*: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORM_{x,y,z}* * *ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.



EX3DV4 SN:3578

March 20, 2006

Probe EX3DV4

SN:3578

Manufactured: November 4, 2005
Calibrated: March 20, 2006

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)



EX3DV4 SN:3578

March 20, 2006

DASY - Parameters of Probe: EX3DV4 SN:3578

Sensitivity in Free Space^A

Diode Compression^B

NormX	0.500 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	93 mV
NormY	0.506 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	93 mV
NormZ	0.550 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	93 mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL 900 MHz Typical SAR gradient: 5 % per mm

Sensor Center to Phantom Surface Distance		2.0 mm	3.0 mm
SAR _{be} [%]	Without Correction Algorithm	3.1	1.1
SAR _{be} [%]	With Correction Algorithm	0.2	0.4

TSL 1750 MHz Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance		2.0 mm	3.0 mm
SAR _{be} [%]	Without Correction Algorithm	2.5	1.0
SAR _{be} [%]	With Correction Algorithm	0.2	0.3

Sensor Offset

Probe Tip to Sensor Center 1.0 mm

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 8).

^B Numerical linearization parameter: uncertainty not required.

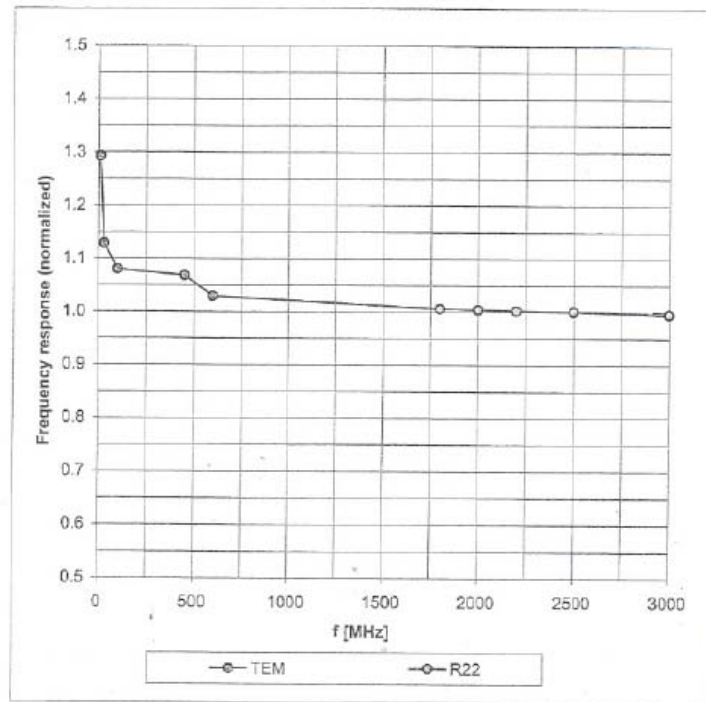


EX3DV4 SN:3578

March 20, 2006

Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide: R22)



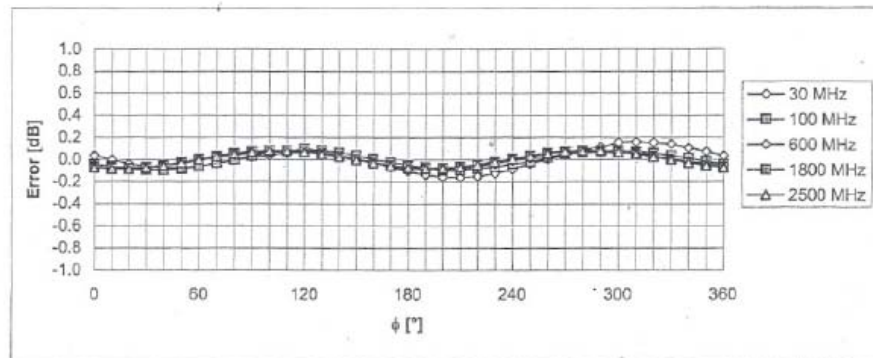
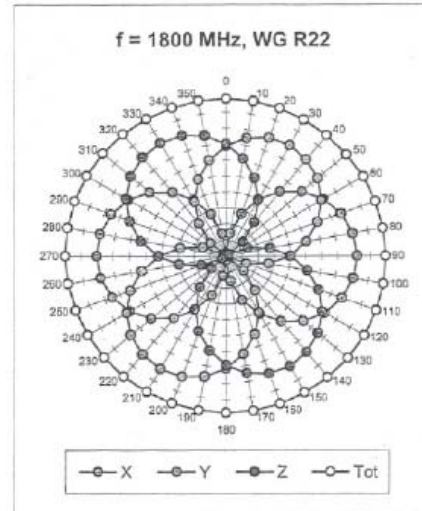
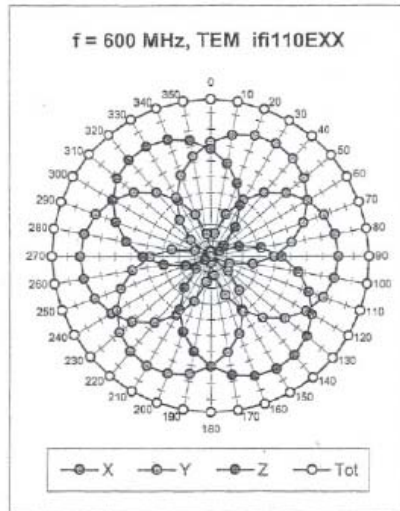
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)



EX3DV4 SN:3578

March 20, 2006

Receiving Pattern (ϕ), $\vartheta = 0^\circ$



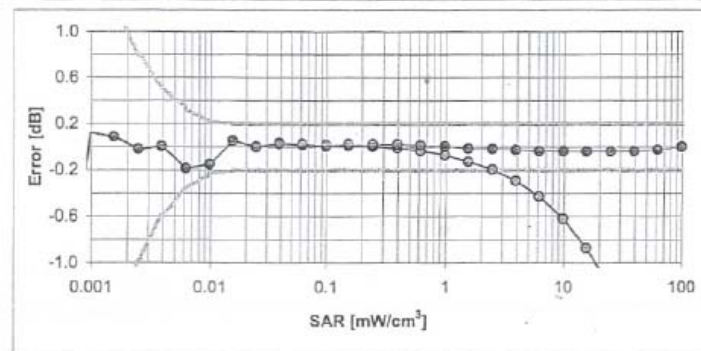
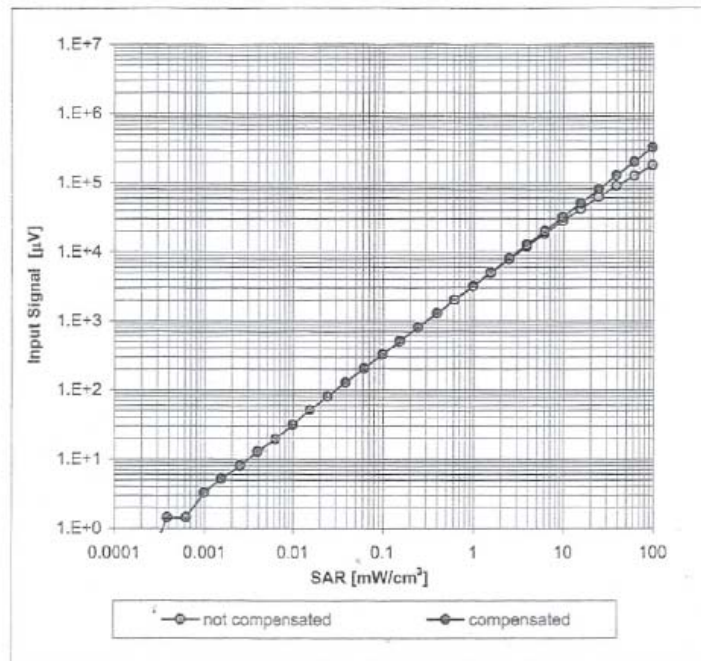
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)



EX3DV4 SN:3578

March 20, 2006

Dynamic Range $f(\text{SAR}_{\text{head}})$ (Waveguide R22, $f = 1800$ MHz)



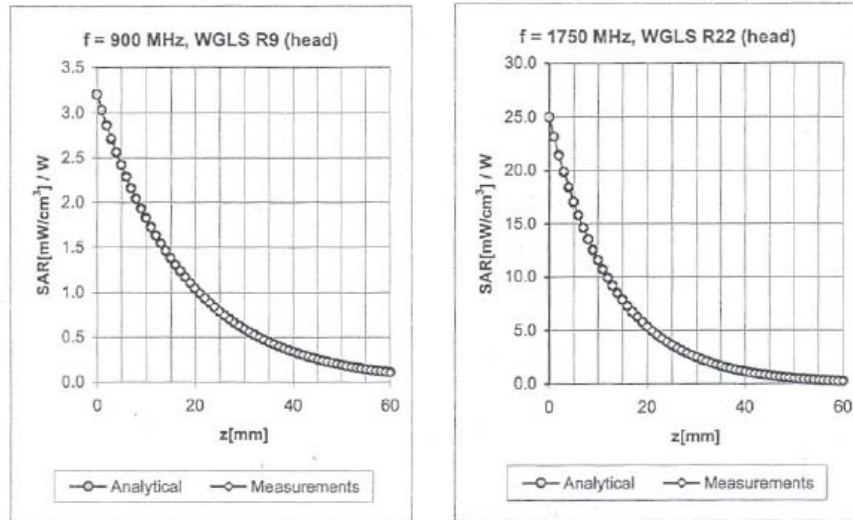
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)



EX3DV4 SN:3578

March 20, 2006

Conversion Factor Assessment



f [MHz]	Validity [MHz] ^c	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.66	0.66	8.38 ± 11.0% (k=2)
1750	± 50 / ± 100	Head	40.1 ± 5%	1.37 ± 5%	0.59	0.80	7.30 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.59	0.80	6.98 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.52	0.80	6.47 ± 11.8% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.78	0.64	8.15 ± 11.0% (k=2)
1750	± 50 / ± 100	Body	53.4 ± 5%	1.49 ± 5%	0.63	0.68	7.03 ± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.42	0.87	6.75 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.59	0.73	6.47 ± 11.8% (k=2)
5200	± 50 / ± 100	Body	49.0 ± 5%	5.30 ± 5%	0.35	1.75	4.11 ± 13.1% (k=2)
5800	± 50 / ± 100	Body	48.2 ± 5%	6.00 ± 5%	0.32	1.75	3.89 ± 13.1% (k=2)

^c The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

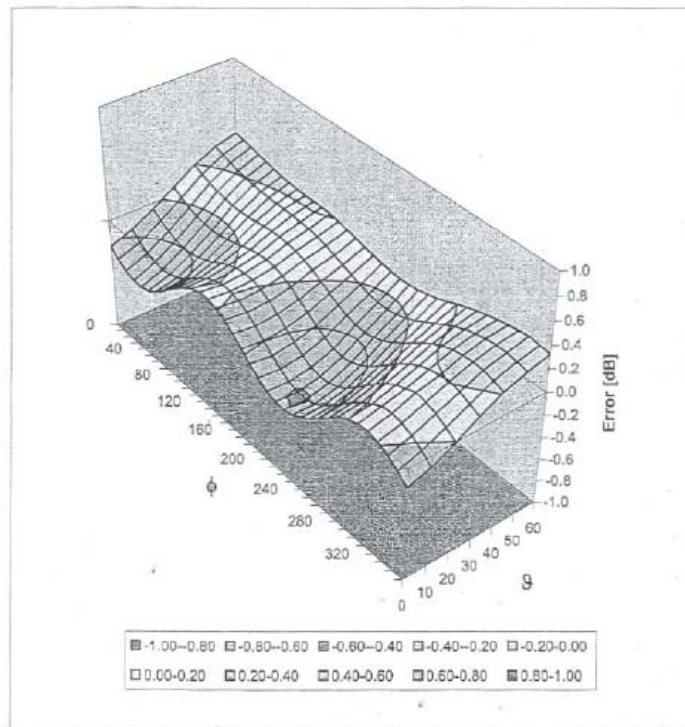


EX3DV4 SN:3578

March 20, 2006

Deviation from Isotropy in HSL

Error (ϕ , θ), $f = 900$ MHz



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)



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Accreditation No.: SCS 108

Client Sporton (Auden)

Certificate No: DAE3-577_Nov05

CALIBRATION CERTIFICATE

Object: DAE3 - SD 000 D03 AA - SN: 577
Calibration procedure(s): QA CAL-06.v12 Calibration procedure for the data acquisition electronics (DAE)
Calibration date: November 11, 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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Table with 4 columns: Primary Standards, ID #, Cal Date (Calibrated by, Certificate No.), Scheduled Calibration. Includes entries for Fluke Process Calibrator Type 702 and Calibrator Box V1.1.

Calibrated by: Daniel Steinacher, Technician, [Signature]
Approved by: Fin Bornholt, R&D Director, [Signature]

Issued: November 11, 2005

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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 = 6.1µV , 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	404.445 ± 0.1% (k=2)	403.896 ± 0.1% (k=2)	404.369 ± 0.1% (k=2)
Low Range	3.94241 ± 0.7% (k=2)	3.89919 ± 0.7% (k=2)	3.95427 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	130 ° ± 1 °
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Appendix

1. DC Voltage Linearity

High Range	Input (μV)	Reading (μV)	Error (%)
Channel X + Input	200000	199999.3	0.00
Channel X + Input	20000	20006.75	0.03
Channel X - Input	20000	-19997.90	-0.01
Channel Y + Input	200000	200000.3	0.00
Channel Y + Input	20000	20004.58	0.02
Channel Y - Input	20000	-20000.75	0.00
Channel Z + Input	200000	199999.6	0.00
Channel Z + Input	20000	20001.43	0.01
Channel Z - Input	20000	-20003.93	0.02

Low Range	Input (μV)	Reading (μV)	Error (%)
Channel X + Input	2000	2000.1	0.00
Channel X + Input	200	200.42	0.21
Channel X - Input	200	-200.30	0.15
Channel Y + Input	2000	2000.1	0.00
Channel Y + Input	200	199.35	-0.32
Channel Y - Input	200	-200.96	0.48
Channel Z + Input	2000	1999.9	0.00
Channel Z + Input	200	199.37	-0.31
Channel Z - Input	200	-200.82	0.31

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	13.40	12.55
	- 200	-12.29	-13.06
Channel Y	200	-6.93	-7.43
	- 200	6.72	6.47
Channel Z	200	0.71	0.36
	- 200	-1.67	-1.93

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	-	1.59	0.08
Channel Y	200	1.69	-	3.62
Channel Z	200	-0.73	-1.49	-



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	15946	15679
Channel Y	15960	16151
Channel Z	16233	15968

5. Input Offset Measurement

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

Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.08	-1.13	2.31	0.51
Channel Y	-0.35	-2.00	0.81	0.43
Channel Z	-0.38	-2.76	1.68	0.40

6. Input Offset Current

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

7. Input Resistance

	Zeroing (MΩ)	Measuring (MΩ)
Channel X	0.2000	200.8
Channel Y	0.2000	201.4
Channel Z	0.2001	200.3

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