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Accreditation No.: SCS 0108

Client **Apple**

Certificate No: EX3-3987_Feb15

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3987
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	February 17, 2015

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
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Israe Elnaouq	Laboratory Technician	Israe Elnaouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 19, 2015

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
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., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 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 *NORMx,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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3987

Manufactured: November 11, 2013
Calibrated: February 17, 2015

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3987

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.55	0.42	0.46	± 10.1 %
DCP (mV)[B]	98.0	107.7	102.5	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	122.7	±2.7 %
		Y	0.0	0.0	1.0		125.9	
		Z	0.0	0.0	1.0		119.0	
10011-CAB	UMTS-FDD (WCDMA)	X	3.21	65.4	17.3	2.91	131.5	±0.7 %
		Y	3.72	69.6	19.7		135.6	
		Z	3.51	68.1	19.0		129.8	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.69	66.2	17.1	1.87	129.5	±0.9 %
		Y	3.88	74.4	21.3		132.9	
		Z	3.20	70.6	19.6		128.6	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.52	68.7	22.0	9.46	124.0	±3.0 %
		Y	10.49	69.2	22.1		147.2	
		Z	10.76	69.9	22.7		146.8	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	3.32	71.5	17.0	9.39	128.0	±1.9 %
		Y	1.93	63.7	12.1		84.1	
		Z	2.44	68.8	15.6		109.1	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	3.04	69.9	16.5	9.57	121.7	±2.5 %
		Y	1.81	62.1	11.2		81.2	
		Z	2.31	67.6	15.2		104.7	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	2.87	70.2	14.9	6.56	135.6	±1.9 %
		Y	2.27	68.4	13.0		134.9	
		Z	3.20	73.7	15.9		136.5	
10030-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH1)	X	3.23	71.4	14.1	5.30	149.8	±1.4 %
		Y	1.25	61.8	8.7		131.9	
		Z	1.61	64.9	10.8		129.3	
10031-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH3)	X	13.67	84.7	15.7	1.87	133.8	±1.4 %
		Y	0.63	62.3	7.6		144.0	
		Z	64.50	99.8	19.2		138.8	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	0.93	64.8	8.8	1.16	140.3	±1.4 %
		Y	0.37	60.1	5.9		149.2	
		Z	55.92	99.6	18.7		146.1	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.77	66.3	18.5	4.57	143.5	±1.2 %
		Y	4.75	67.5	19.3		126.6	
		Z	4.80	67.4	19.2		149.8	
10056-CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	X	5.26	72.8	25.3	11.01	126.8	±1.4 %
		Y	4.30	69.1	22.9		83.9	
		Z	4.48	70.4	24.2		109.0	

10062-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.42	69.0	21.7	8.68	141.7	±3.0 %
		Y	9.94	68.3	21.1		126.2	
		Z	10.39	69.4	21.9		148.7	
10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.93	65.4	17.8	3.97	140.9	±0.9 %
		Y	4.00	67.1	18.9		128.4	
		Z	4.08	67.2	19.1		148.3	
10097-CAB	UMTS-FDD (HSDPA)	X	4.59	65.9	17.9	3.98	130.9	±0.9 %
		Y	4.82	67.9	19.1		144.4	
		Z	4.74	67.3	18.8		140.0	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.59	65.9	17.9	3.98	131.9	±1.2 %
		Y	4.80	67.9	19.0		145.2	
		Z	4.80	67.6	19.1		141.5	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.44	66.9	19.2	5.67	137.5	±1.7 %
		Y	6.51	67.8	19.7		147.4	
		Z	6.56	67.7	19.8		147.4	
10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	8.50	70.5	23.3	9.29	138.9	±2.5 %
		Y	7.52	68.1	21.8		139.7	
		Z	8.03	69.7	22.9		143.6	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.29	66.4	19.1	5.80	133.9	±1.7 %
		Y	6.32	67.2	19.5		146.3	
		Z	6.39	67.3	19.7		142.9	
10110-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.94	65.8	18.8	5.75	130.6	±1.7 %
		Y	5.95	66.7	19.3		139.7	
		Z	6.08	67.0	19.6		145.2	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.07	68.1	20.7	8.07	125.7	±2.7 %
		Y	10.00	68.4	20.7		131.9	
		Z	10.15	68.6	21.0		135.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	8.04	69.9	23.0	9.28	134.1	±2.5 %
		Y	7.20	67.8	21.7		137.5	
		Z	7.60	69.1	22.8		140.7	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.96	65.9	18.8	5.75	130.2	±1.7 %
		Y	6.00	66.9	19.4		142.1	
		Z	6.01	66.7	19.4		138.3	
10156-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.72	65.5	18.7	5.79	126.5	±1.7 %
		Y	5.75	66.7	19.4		135.0	
		Z	5.81	66.7	19.5		139.6	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.40	66.4	19.1	5.82	134.9	±1.9 %
		Y	6.44	67.3	19.5		145.7	
		Z	6.52	67.4	19.7		145.6	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.95	66.1	19.0	5.73	133.8	±1.4 %
		Y	4.88	67.1	19.8		140.2	
		Z	4.90	66.9	19.7		141.6	
10170-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	5.63	67.0	19.9	6.52	130.8	±1.7 %
		Y	5.47	67.7	20.3		137.4	
		Z	5.52	67.5	20.4		138.2	

10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	6.54	71.5	24.2	9.21	145.0	±2.7 %
		Y	5.93	70.1	23.2		145.7	
		Z	6.06	70.7	23.9		147.7	
10173-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	6.85	72.2	24.6	9.48	143.4	±2.7 %
		Y	6.24	71.1	23.7		145.9	
		Z	6.31	71.3	24.2		144.6	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.92	66.0	19.0	5.72	131.7	±1.4 %
		Y	4.88	67.2	19.8		142.2	
		Z	4.89	66.9	19.8		138.3	
10176-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.62	66.9	19.8	6.52	131.4	±1.9 %
		Y	5.45	67.6	20.3		137.8	
		Z	5.52	67.5	20.4		136.7	
10177-CAE	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	4.92	66.0	19.0	5.73	132.6	±1.4 %
		Y	4.87	67.1	19.7		137.6	
		Z	4.92	67.0	19.8		139.5	
10178-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.63	67.0	19.9	6.52	131.9	±1.9 %
		Y	5.44	67.6	20.3		136.6	
		Z	5.52	67.6	20.4		136.8	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.91	65.9	18.9	5.72	133.3	±1.4 %
		Y	4.88	67.2	19.8		137.3	
		Z	4.88	66.8	19.7		138.3	
10182-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.64	67.0	19.9	6.52	132.0	±1.9 %
		Y	5.42	67.4	20.2		136.0	
		Z	5.56	67.7	20.5		138.3	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.08	68.8	21.2	8.10	146.5	±3.3 %
		Y	9.89	68.9	21.1		147.6	
		Z	9.69	68.2	20.9		126.0	
10225-CAB	UMTS-FDD (HSPA+)	X	7.18	67.2	19.4	5.97	149.9	±1.9 %
		Y	6.95	67.3	19.4		129.7	
		Z	6.99	67.3	19.6		130.4	
10232-CAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	6.58	71.1	23.9	9.48	127.2	±2.2 %
		Y	6.21	71.0	23.6		145.7	
		Z	6.38	71.7	24.5		148.8	
10234-CAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	6.51	71.3	24.1	9.21	145.6	±2.7 %
		Y	5.96	70.2	23.3		148.7	
		Z	6.09	70.8	24.0		148.6	
10235-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	6.81	72.0	24.5	9.48	145.2	±2.7 %
		Y	6.24	71.1	23.7		146.9	
		Z	6.33	71.4	24.3		145.7	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	6.45	71.0	23.9	9.21	145.6	±2.7 %
		Y	5.97	70.4	23.4		149.8	
		Z	6.08	70.8	24.0		147.8	
10238-CAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	6.83	72.2	24.5	9.48	144.6	±2.5 %
		Y	6.23	71.1	23.7		147.3	
		Z	6.34	71.5	24.3		145.6	

10240-CAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	6.52	71.4	24.1	9.21	146.6	±2.7 %
		Y	5.76	69.3	22.8		129.3	
		Z	6.07	70.7	23.9		147.8	
10249-CAB	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	7.43	69.9	23.4	9.29	144.0	±3.0 %
		Y	6.73	68.3	22.2		147.6	
		Z	6.94	69.0	22.9		144.7	
10251-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	8.89	70.0	23.7	10.17	135.5	±3.3 %
		Y	8.13	68.3	22.4		139.9	
		Z	8.44	69.3	23.4		138.1	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	7.49	69.1	22.7	9.24	127.5	±2.5 %
		Y	6.81	67.5	21.7		131.9	
		Z	7.07	68.3	22.4		129.3	
10255-CAB	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	7.94	69.7	22.9	9.20	134.6	±2.5 %
		Y	7.13	67.6	21.6		137.7	
		Z	7.48	68.8	22.6		136.5	
10264-CAB	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	7.51	69.3	22.8	9.23	128.3	±2.5 %
		Y	6.80	67.5	21.7		133.2	
		Z	7.10	68.5	22.6		130.1	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	8.05	69.9	23.1	9.30	135.0	±2.5 %
		Y	7.22	67.8	21.8		137.5	
		Z	7.62	69.1	22.8		136.0	
10270-CAB	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	8.81	70.6	23.5	9.58	142.7	±2.7 %
		Y	7.81	68.0	21.9		143.6	
		Z	8.30	69.5	23.0		143.4	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	6.03	66.6	18.5	4.87	143.6	±1.4 %
		Y	6.05	67.7	19.1		127.6	
		Z	6.20	68.0	19.4		149.6	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.47	66.1	18.0	3.96	147.5	±0.9 %
		Y	4.59	67.8	19.2		131.0	
		Z	4.51	67.1	18.9		130.9	
10290-AAB	CDMA2000, RC1, SO55, Full Rate	X	4.27	66.2	18.0	3.91	141.2	±0.7 %
		Y	4.56	69.1	19.7		147.1	
		Z	4.47	68.4	19.5		146.5	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.63	65.9	17.7	3.46	140.9	±0.7 %
		Y	3.89	68.8	19.5		146.5	
		Z	3.86	68.3	19.4		147.0	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.56	65.7	17.6	3.39	140.6	±0.7 %
		Y	3.85	69.0	19.5		146.2	
		Z	3.74	68.0	19.2		146.1	
10293-AAB	CDMA2000, RC3, SO3, Full Rate	X	3.63	65.7	17.7	3.50	141.8	±0.7 %
		Y	3.91	68.8	19.5		146.5	
		Z	3.87	68.2	19.3		148.0	
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	X	6.35	69.9	25.3	12.49	103.3	±1.7 %
		Y	5.25	65.5	22.3		66.9	
		Z	5.62	67.6	24.1		89.5	

10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.26	66.3	19.0	5.81	131.9	±1.7 %
		Y	6.33	67.3	19.5		144.5	
		Z	6.37	67.2	19.7		139.4	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.87	67.0	19.4	6.06	140.1	±1.9 %
		Y	6.65	66.9	19.4		125.1	
		Z	6.99	67.9	20.0		147.3	
10400-AAB	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.36	69.1	21.5	8.37	148.3	±3.3 %
		Y	9.84	68.3	20.9		126.6	
		Z	9.91	68.3	21.1		125.8	
10401-AAB	IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle)	X	10.78	68.8	21.3	8.60	133.3	±3.0 %
		Y	10.61	68.9	21.2		137.3	
		Z	10.73	69.0	21.5		135.9	
10402-AAB	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	10.98	69.2	21.3	8.53	134.7	±3.0 %
		Y	10.59	68.6	20.9		136.4	
		Z	11.01	69.5	21.5		138.9	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.75	67.7	18.2	3.76	130.5	±0.7 %
		Y	5.60	72.6	20.5		134.7	
		Z	5.46	71.8	20.4		134.1	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.67	67.8	18.2	3.77	127.5	±0.9 %
		Y	5.82	73.7	21.0		130.2	
		Z	5.40	72.0	20.5		131.2	
10406-AAA	CDMA2000, RC3, SO32, SCH0, Full Rate	X	6.23	68.6	19.4	5.22	132.3	±1.2 %
		Y	6.54	71.3	20.7		134.9	
		Z	6.42	70.6	20.5		135.6	
10410-AAA	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	5.97	69.0	21.9	7.82	141.6	±2.2 %
		Y	5.62	68.9	21.9		144.4	
		Z	5.71	69.0	22.2		145.8	

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 E^2-field uncertainty inside TSL (see Pages 9 and 10).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3987

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	10.51	10.51	10.51	0.19	1.27	± 12.0 %
835	41.5	0.90	10.19	10.19	10.19	0.23	1.16	± 12.0 %
900	41.5	0.97	9.93	9.93	9.93	0.29	0.88	± 12.0 %
1450	40.5	1.20	9.03	9.03	9.03	0.18	1.42	± 12.0 %
1750	40.1	1.37	8.78	8.78	8.78	0.37	0.82	± 12.0 %
1900	40.0	1.40	8.51	8.51	8.51	0.43	0.77	± 12.0 %
1950	40.0	1.40	8.15	8.15	8.15	0.39	0.80	± 12.0 %
2000	40.0	1.40	8.33	8.33	8.33	0.72	0.60	± 12.0 %
2300	39.5	1.67	7.86	7.86	7.86	0.40	0.82	± 12.0 %
2450	39.2	1.80	7.49	7.49	7.49	0.44	0.78	± 12.0 %
2600	39.0	1.96	7.35	7.35	7.35	0.30	1.01	± 12.0 %
5200	36.0	4.66	5.27	5.27	5.27	0.30	1.80	± 13.1 %
5300	35.9	4.76	5.04	5.04	5.04	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.92	4.92	4.92	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.80	4.80	4.80	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.84	4.84	4.84	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

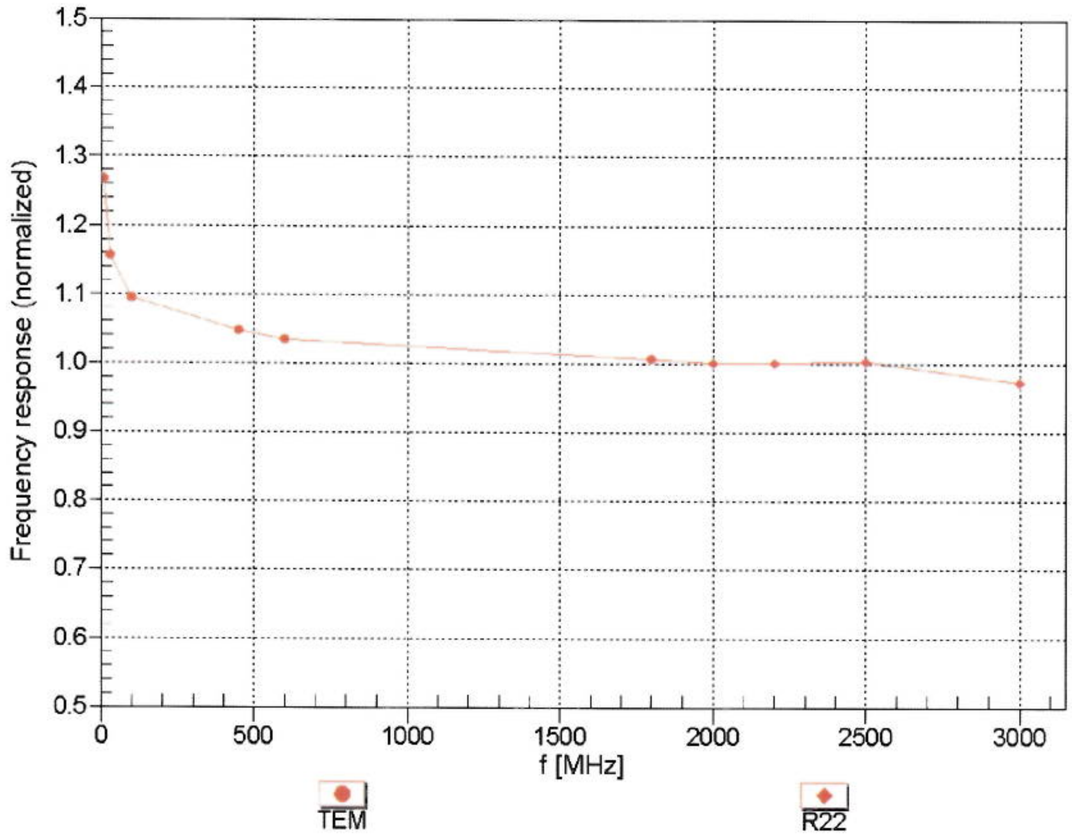
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3987

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	10.22	10.22	10.22	0.52	0.80	± 12.0 %
835	55.2	0.97	10.16	10.16	10.16	0.42	0.86	± 12.0 %
900	55.0	1.05	9.94	9.94	9.94	0.31	1.02	± 12.0 %
1450	54.0	1.30	8.50	8.50	8.50	0.19	1.59	± 12.0 %
1750	53.4	1.49	8.38	8.38	8.38	0.50	0.79	± 12.0 %
1900	53.3	1.52	7.97	7.97	7.97	0.54	0.73	± 12.0 %
1950	53.3	1.52	8.24	8.24	8.24	0.26	1.12	± 12.0 %
2000	53.3	1.52	8.12	8.12	8.12	0.39	0.86	± 12.0 %
2300	52.9	1.81	7.68	7.68	7.68	0.46	0.78	± 12.0 %
2450	52.7	1.95	7.56	7.56	7.56	0.67	0.64	± 12.0 %
2600	52.5	2.16	7.30	7.30	7.30	0.77	0.59	± 12.0 %
5200	49.0	5.30	4.62	4.62	4.62	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.39	4.39	4.39	0.45	1.90	± 13.1 %
5500	48.6	5.65	4.07	4.07	4.07	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.91	3.91	3.91	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.18	4.18	4.18	0.50	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

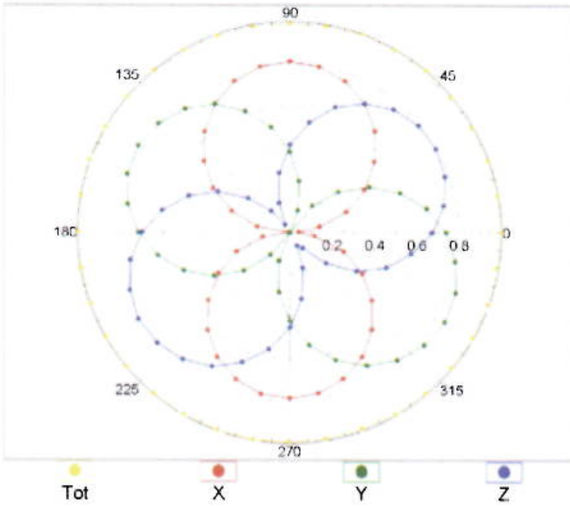
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



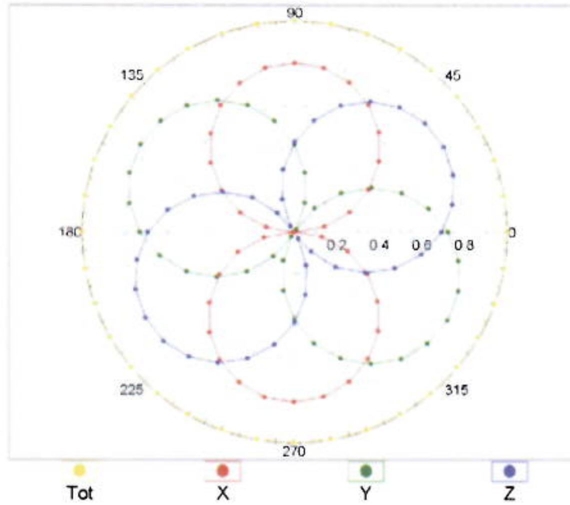
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

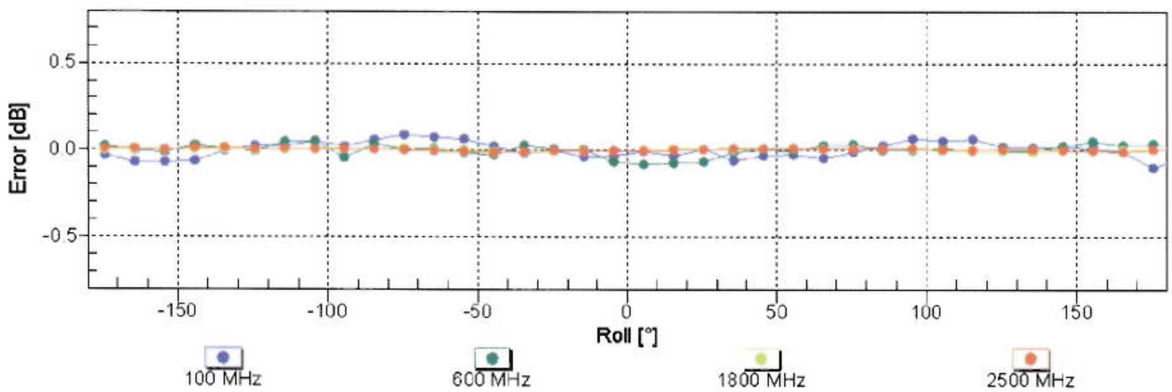
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



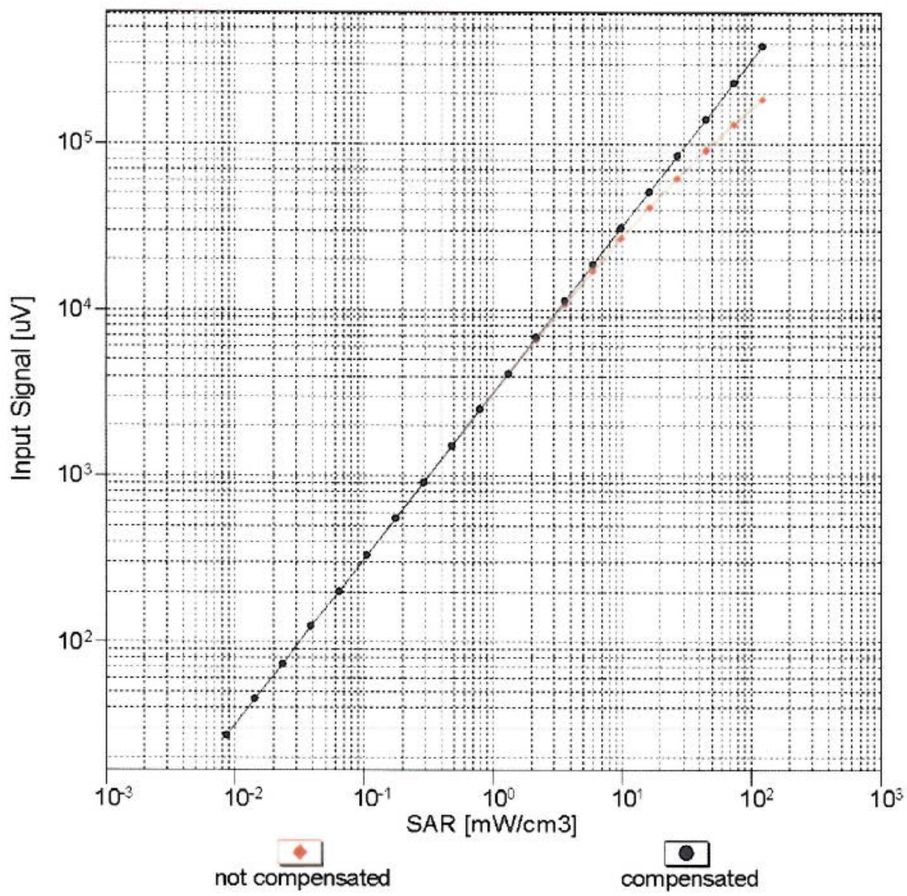
f=1800 MHz,R22

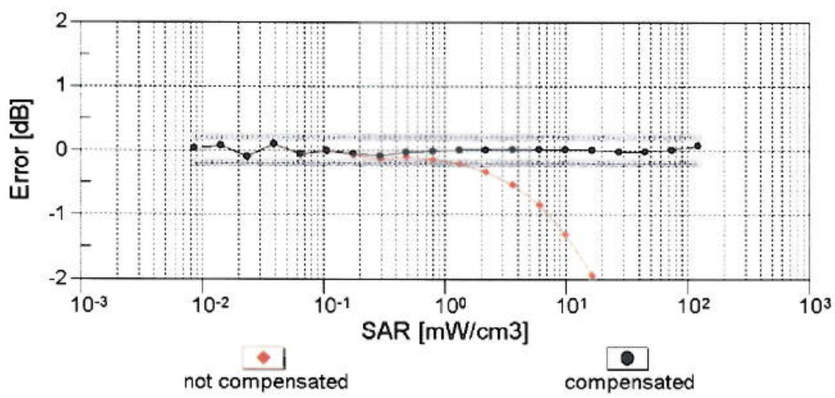




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

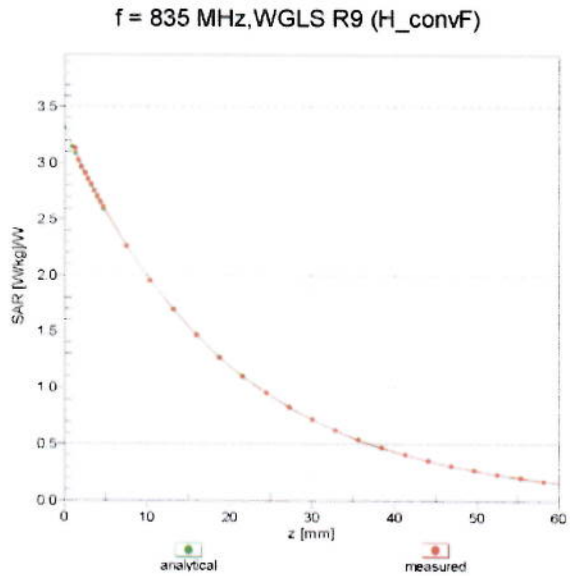
Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

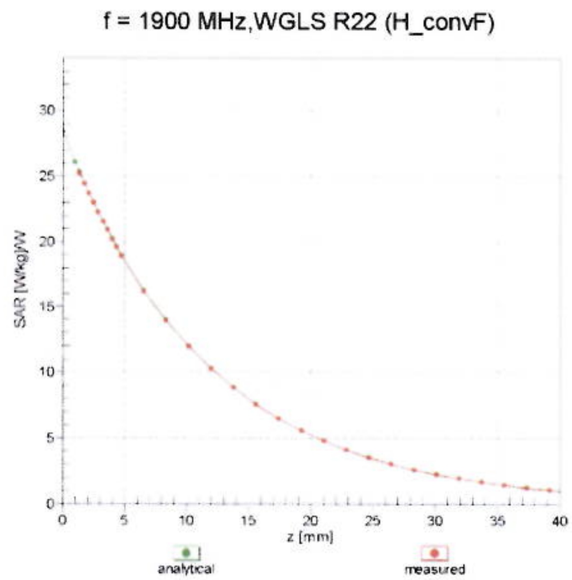




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

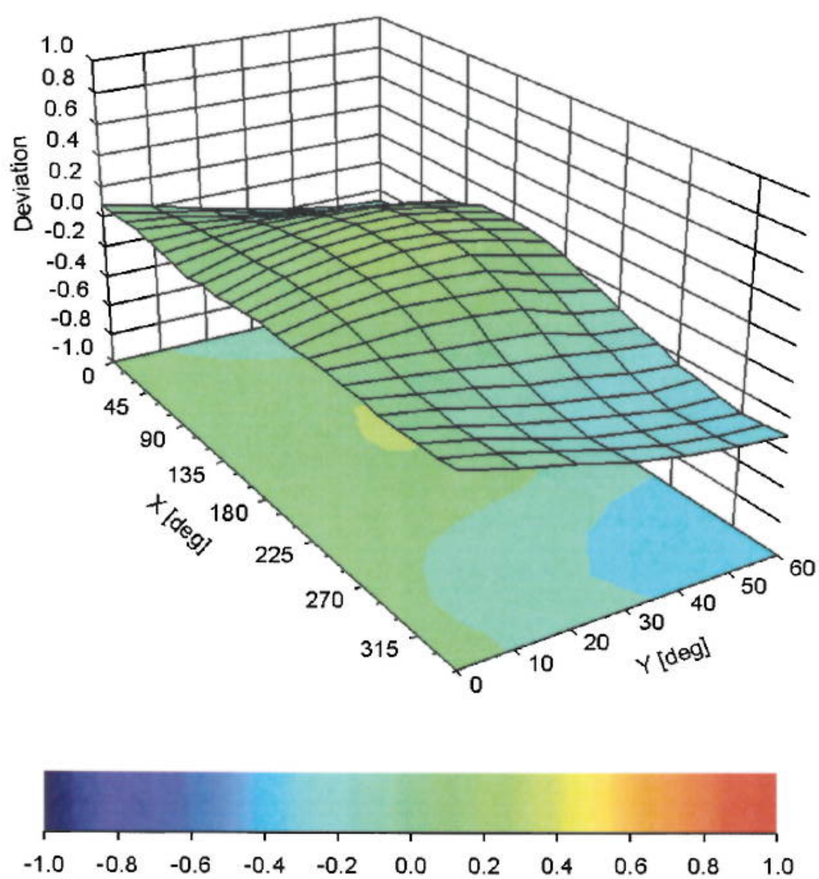
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3987

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-84.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

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 0108

Client **Apple**

Certificate No: EX3-3988_Feb15

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3988
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	February 17, 2015

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
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Israe Elnaouq	Laboratory Technician	Israe Elnaouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 19, 2015

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
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., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z*: *A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 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 *NORMx,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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3988

Manufactured: November 11, 2013
Calibrated: February 17, 2015

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3988

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.38	0.44	0.28	± 10.1 %
DCP (mV)[B]	103.8	101.1	100.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	116.2	±2.5 %
		Y	0.0	0.0	1.0		106.0	
		Z	0.0	0.0	1.0		119.4	
10011-CAB	UMTS-FDD (WCDMA)	X	3.48	67.2	18.2	2.91	141.2	±0.5 %
		Y	3.25	65.5	17.1		135.5	
		Z	3.39	67.5	18.8		129.4	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.17	69.5	18.7	1.87	139.4	±0.9 %
		Y	2.64	65.5	16.3		133.0	
		Z	3.01	69.9	19.6		148.2	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.68	69.3	22.2	9.46	136.3	±3.5 %
		Y	10.68	69.2	22.0		149.4	
		Z	10.58	68.9	22.1		141.8	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	2.57	66.0	13.7	9.39	104.4	±2.2 %
		Y	2.27	64.9	13.3		85.8	
		Z	1.65	65.3	14.0		77.5	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	2.52	65.7	13.7	9.57	100.3	±3.0 %
		Y	2.28	64.9	13.6		83.0	
		Z	1.56	64.2	13.4		75.0	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	2.93	70.2	14.3	6.56	147.5	±1.4 %
		Y	2.02	65.3	11.9		136.4	
		Z	6.78	86.9	20.7		138.5	
10030-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH1)	X	1.67	63.3	9.7	5.30	140.0	±1.4 %
		Y	1.56	63.0	9.9		134.7	
		Z	1.21	63.9	10.2		140.3	
10031-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH3)	X	0.81	62.2	7.9	1.87	148.5	±1.4 %
		Y	0.75	62.2	8.2		145.3	
		Z	30.61	99.8	20.0		136.3	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	0.39	59.0	6.0	1.16	133.0	±2.5 %
		Y	0.50	60.9	7.1		149.2	
		Z	0.28	98.0	39.6		142.5	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.74	66.5	18.5	4.57	134.3	±0.9 %
		Y	4.56	65.4	17.8		128.7	
		Z	4.68	66.8	19.1		145.5	
10056-CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	X	4.86	70.4	23.4	11.01	103.4	±1.4 %
		Y	4.38	67.8	22.1		84.5	
		Z	3.64	65.9	22.1		78.2	

10062-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.17	68.5	21.2	8.68	131.3	±3.5 %
		Y	10.04	68.1	20.9		127.5	
		Z	10.38	69.0	21.6		149.4	
10081-CAB	CDMA2000 (1xRTT, RC3)	X	4.02	66.3	18.3	3.97	136.7	±0.7 %
		Y	3.84	65.0	17.3		132.8	
		Z	3.95	66.5	18.8		145.7	
10097-CAB	UMTS-FDD (HSDPA)	X	4.63	66.3	18.0	3.98	127.7	±0.9 %
		Y	4.56	65.6	17.5		144.6	
		Z	4.71	67.1	18.9		139.5	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.65	66.5	18.1	3.98	127.9	±0.9 %
		Y	4.64	66.0	17.7		146.8	
		Z	4.77	67.3	18.9		140.5	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.41	67.0	19.1	5.67	132.2	±1.4 %
		Y	6.22	66.0	18.5		126.6	
		Z	6.48	67.2	19.5		144.7	
10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	7.95	68.9	22.1	9.29	132.5	±2.2 %
		Y	7.73	68.0	21.6		146.4	
		Z	7.41	67.2	21.5		133.8	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.21	66.3	18.9	5.80	125.7	±1.7 %
		Y	6.29	66.3	18.8		147.3	
		Z	6.35	66.9	19.5		140.9	
10110-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.92	66.1	18.8	5.75	126.7	±1.4 %
		Y	5.97	66.0	18.6		140.7	
		Z	6.00	66.5	19.3		134.9	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.32	68.8	20.9	8.07	143.5	±3.3 %
		Y	10.05	68.1	20.4		133.1	
		Z	10.16	68.3	20.8		127.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	7.58	68.5	22.0	9.28	128.7	±2.5 %
		Y	7.41	67.7	21.5		139.8	
		Z	7.16	67.2	21.7		149.0	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.07	66.6	19.1	5.75	145.5	±1.7 %
		Y	6.01	66.1	18.7		143.2	
		Z	6.01	66.4	19.3		137.6	
10156-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.83	66.4	19.0	5.79	140.9	±1.4 %
		Y	5.72	65.6	18.5		135.8	
		Z	5.73	66.2	19.3		130.0	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.31	66.4	18.9	5.82	126.6	±1.7 %
		Y	6.40	66.4	18.8		147.2	
		Z	6.50	67.1	19.6		140.0	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.00	66.9	19.4	5.73	148.9	±1.9 %
		Y	4.87	65.9	18.8		142.4	
		Z	4.67	65.8	19.2		133.7	
10170-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	5.62	67.6	20.1	6.52	143.2	±1.9 %
		Y	5.52	66.7	19.5		139.3	
		Z	5.25	66.5	19.9		128.9	

10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	6.07	69.8	23.0	9.21	132.5	±3.0 %
		Y	6.12	69.6	22.7		148.5	
		Z	5.50	68.2	22.6		135.4	
10173-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	6.34	70.6	23.3	9.48	132.4	±2.7 %
		Y	6.42	70.5	23.2		149.0	
		Z	5.75	69.0	23.0		136.0	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.96	66.7	19.3	5.72	147.5	±1.4 %
		Y	4.87	65.8	18.7		143.6	
		Z	4.71	66.1	19.4		135.5	
10176-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.59	67.4	20.0	6.52	141.8	±1.7 %
		Y	5.58	66.9	19.6		141.1	
		Z	5.26	66.5	19.9		129.5	
10177-CAE	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	4.95	66.7	19.3	5.73	143.5	±1.4 %
		Y	4.86	65.9	18.7		139.3	
		Z	4.70	66.0	19.3		132.5	
10178-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.57	67.3	19.9	6.52	141.6	±1.9 %
		Y	5.51	66.7	19.5		139.6	
		Z	5.26	66.5	19.9		129.2	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.94	66.7	19.3	5.72	143.8	±1.4 %
		Y	4.86	65.9	18.7		140.0	
		Z	4.72	66.2	19.5		132.0	
10182-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.59	67.5	20.0	6.52	141.6	±1.9 %
		Y	5.54	66.8	19.5		139.5	
		Z	5.26	66.5	19.9		128.1	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.74	68.1	20.6	8.10	130.0	±3.0 %
		Y	9.64	67.7	20.3		124.0	
		Z	10.04	68.8	21.2		144.4	
10225-CAB	UMTS-FDD (HSPA+)	X	7.05	67.1	19.2	5.97	134.7	±1.4 %
		Y	6.90	66.4	18.7		131.0	
		Z	6.88	66.7	19.3		124.7	
10232-CAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	6.35	70.6	23.3	9.48	132.8	±2.2 %
		Y	6.21	69.6	22.7		131.6	
		Z	5.74	69.0	23.0		135.3	
10234-CAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	6.10	70.0	23.1	9.21	134.3	±2.7 %
		Y	5.89	68.6	22.2		129.6	
		Z	5.51	68.2	22.6		138.1	
10235-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	6.34	70.6	23.4	9.48	132.7	±2.7 %
		Y	6.42	70.6	23.2		149.5	
		Z	5.76	69.2	23.1		136.1	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	6.08	69.9	23.0	9.21	134.8	±2.5 %
		Y	5.88	68.5	22.1		130.3	
		Z	5.55	68.5	22.8		139.6	
10238-CAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	6.33	70.6	23.3	9.48	132.9	±3.0 %
		Y	6.41	70.5	23.2		149.7	
		Z	5.77	69.2	23.2		137.1	

10240-CAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	6.06	69.8	22.9	9.21	134.5	±2.5 %
		Y	5.91	68.7	22.3		130.5	
		Z	5.55	68.5	22.8		139.6	
10249-CAB	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	6.92	68.3	22.1	9.29	132.0	±3.0 %
		Y	6.91	68.0	21.8		149.4	
		Z	6.48	66.9	21.8		138.7	
10251-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	8.57	69.2	23.0	10.17	147.0	±3.0 %
		Y	8.35	68.2	22.3		141.9	
		Z	7.98	67.3	22.2		132.4	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	7.20	68.4	22.0	9.24	137.6	±2.5 %
		Y	6.99	67.3	21.4		135.5	
		Z	6.76	67.0	21.6		144.9	
10255-CAB	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	7.57	68.7	22.1	9.20	143.3	±2.5 %
		Y	7.32	67.4	21.3		140.9	
		Z	6.99	66.7	21.3		130.6	
10264-CAB	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	7.23	68.5	22.1	9.23	138.0	±3.0 %
		Y	6.95	67.2	21.3		134.8	
		Z	6.75	67.0	21.6		144.7	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	7.68	68.9	22.3	9.30	143.9	±2.2 %
		Y	7.41	67.6	21.5		140.3	
		Z	7.08	66.8	21.4		130.4	
10270-CAB	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	8.15	68.6	22.1	9.58	128.6	±2.2 %
		Y	8.00	67.9	21.7		146.5	
		Z	7.72	67.2	21.6		136.0	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.99	66.9	18.5	4.87	131.1	±0.9 %
		Y	5.85	66.1	18.0		129.6	
		Z	6.09	67.3	19.1		147.1	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.51	66.6	18.2	3.96	136.1	±0.7 %
		Y	4.30	65.3	17.4		132.0	
		Z	4.52	67.0	18.9		147.5	
10290-AAB	CDMA2000, RC1, SO55, Full Rate	X	4.31	67.0	18.3	3.91	129.6	±0.9 %
		Y	4.25	66.2	17.7		146.3	
		Z	4.27	67.4	19.0		138.0	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.68	66.7	18.1	3.46	128.6	±0.9 %
		Y	3.60	65.7	17.4		145.9	
		Z	3.71	67.6	19.2		139.7	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.60	66.5	17.9	3.39	128.8	±0.7 %
		Y	3.55	65.7	17.4		146.3	
		Z	3.60	67.3	19.0		137.9	
10293-AAB	CDMA2000, RC3, SO3, Full Rate	X	3.69	66.6	18.1	3.50	128.5	±0.9 %
		Y	3.63	65.8	17.5		146.0	
		Z	3.68	67.2	19.0		136.8	
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	X	5.77	67.2	23.2	12.49	81.4	±0.9 %
		Y	5.43	65.1	22.0		67.7	
		Z	4.84	63.5	21.8		61.7	

10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.36	66.9	19.1	5.81	148.5	±1.7 %
		Y	6.29	66.4	18.8		144.3	
		Z	6.31	66.8	19.4		137.9	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.69	66.6	19.0	6.06	128.9	±1.4 %
		Y	6.57	66.0	18.6		124.8	
		Z	6.94	67.5	19.8		147.0	
10400-AAB	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.03	68.4	20.9	8.37	133.2	±3.0 %
		Y	9.89	67.9	20.6		126.8	
		Z	10.01	68.2	21.0		124.8	
10401-AAB	IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle)	X	10.90	69.2	21.4	8.60	145.6	±3.5 %
		Y	10.68	68.6	21.0		138.7	
		Z	10.83	68.8	21.3		135.2	
10402-AAB	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	11.10	69.5	21.3	8.53	148.0	±3.3 %
		Y	10.66	68.4	20.7		137.5	
		Z	11.01	69.0	21.2		136.3	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	5.05	69.6	18.8	3.76	141.3	±0.7 %
		Y	4.72	67.8	17.9		134.8	
		Z	5.07	70.4	19.8		129.0	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.94	69.5	18.8	3.77	137.1	±0.7 %
		Y	4.57	67.4	17.6		132.5	
		Z	5.08	71.0	20.2		146.4	
10406-AAA	CDMA2000, RC3, SO32, SCH0, Full Rate	X	6.34	69.8	19.8	5.22	143.2	±1.2 %
		Y	6.16	68.7	19.1		137.3	
		Z	6.40	70.7	20.7		126.8	
10410-AAA	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	5.54	67.7	21.0	7.82	129.1	±2.5 %
		Y	5.68	67.9	21.0		146.7	
		Z	5.30	67.3	21.3		136.1	

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 E^2-field uncertainty inside TSL (see Pages 9 and 10).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3988

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	10.99	10.99	10.99	0.47	0.82	± 12.0 %
835	41.5	0.90	10.50	10.50	10.50	0.19	1.48	± 12.0 %
900	41.5	0.97	10.35	10.35	10.35	0.17	1.51	± 12.0 %
1450	40.5	1.20	9.19	9.19	9.19	0.38	0.86	± 12.0 %
1750	40.1	1.37	8.67	8.67	8.67	0.55	0.65	± 12.0 %
1900	40.0	1.40	8.35	8.35	8.35	0.80	0.57	± 12.0 %
1950	40.0	1.40	8.15	8.15	8.15	0.34	0.85	± 12.0 %
2000	40.0	1.40	8.22	8.22	8.22	0.35	0.80	± 12.0 %
2300	39.5	1.67	7.92	7.92	7.92	0.27	0.90	± 12.0 %
2450	39.2	1.80	7.56	7.56	7.56	0.40	0.71	± 12.0 %
2600	39.0	1.96	7.26	7.26	7.26	0.25	1.12	± 12.0 %
5200	36.0	4.66	5.46	5.46	5.46	0.30	1.80	± 13.1 %
5300	35.9	4.76	5.32	5.32	5.32	0.30	1.80	± 13.1 %
5500	35.6	4.96	5.06	5.06	5.06	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.87	4.87	4.87	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.85	4.85	4.85	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3988

Calibration Parameter Determined in Body Tissue Simulating Media

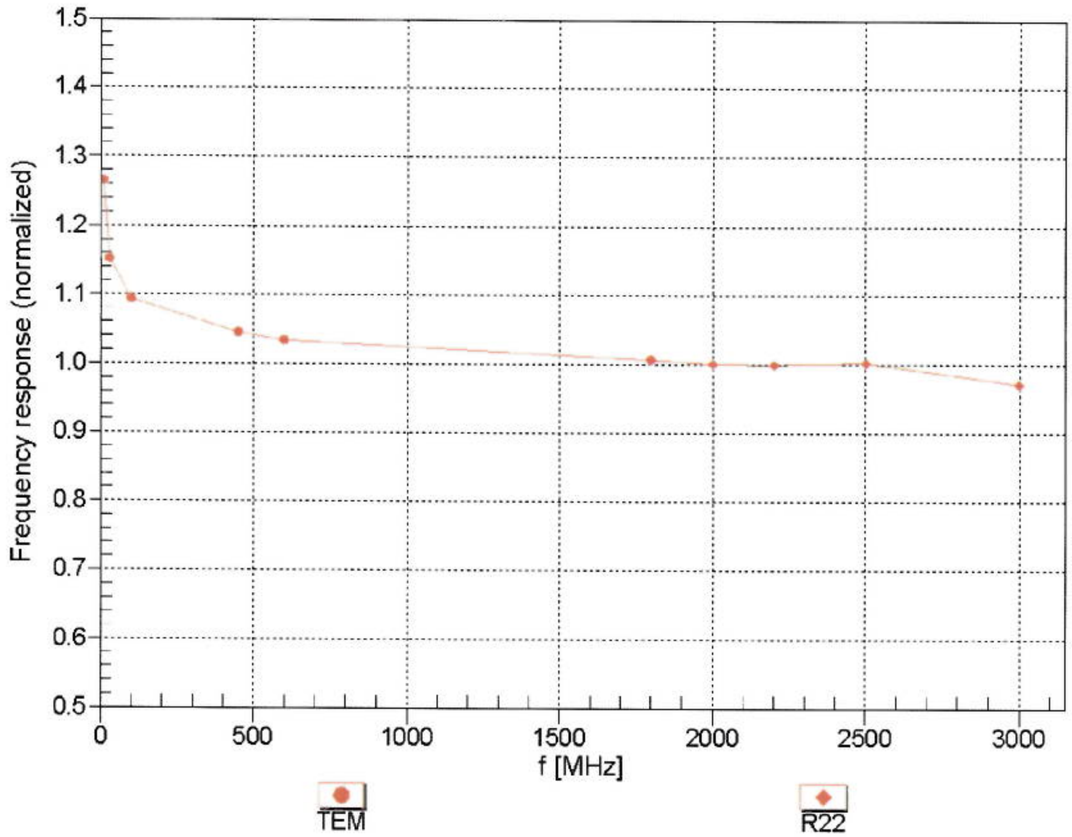
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	10.08	10.08	10.08	0.18	1.63	± 12.0 %
835	55.2	0.97	10.22	10.22	10.22	0.24	1.27	± 12.0 %
900	55.0	1.05	9.95	9.95	9.95	0.29	1.11	± 12.0 %
1450	54.0	1.30	8.77	8.77	8.77	0.31	1.07	± 12.0 %
1750	53.4	1.49	8.34	8.34	8.34	0.46	0.81	± 12.0 %
1900	53.3	1.52	8.03	8.03	8.03	0.36	0.79	± 12.0 %
1950	53.3	1.52	8.21	8.21	8.21	0.31	1.04	± 12.0 %
2000	53.3	1.52	8.10	8.10	8.10	0.45	0.82	± 12.0 %
2300	52.9	1.81	7.72	7.72	7.72	0.45	0.79	± 12.0 %
2450	52.7	1.95	7.53	7.53	7.53	0.56	0.69	± 12.0 %
2600	52.5	2.16	7.26	7.26	7.26	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.79	4.79	4.79	0.40	1.90	± 13.1 %
5300	48.9	5.42	4.59	4.59	4.59	0.40	1.90	± 13.1 %
5500	48.6	5.65	4.30	4.30	4.30	0.45	1.90	± 13.1 %
5600	48.5	5.77	4.20	4.20	4.20	0.45	1.90	± 13.1 %
5800	48.2	6.00	4.42	4.42	4.42	0.50	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

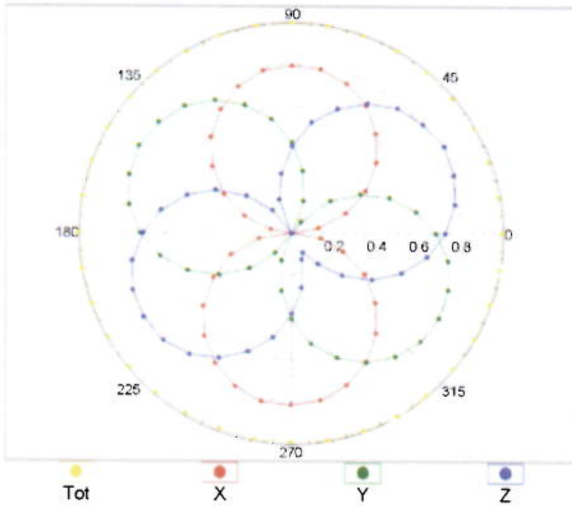
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



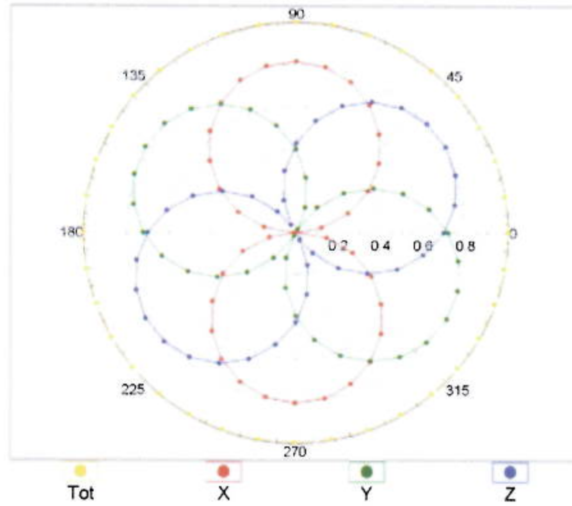
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

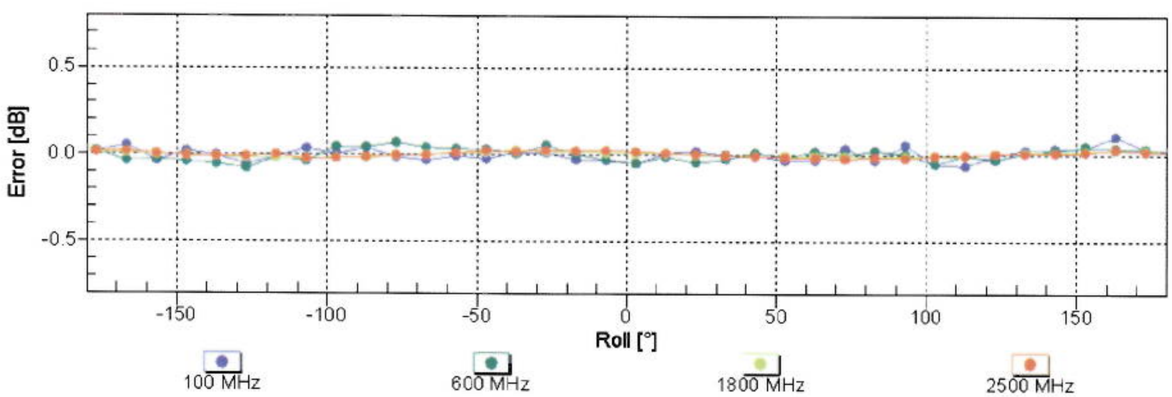
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



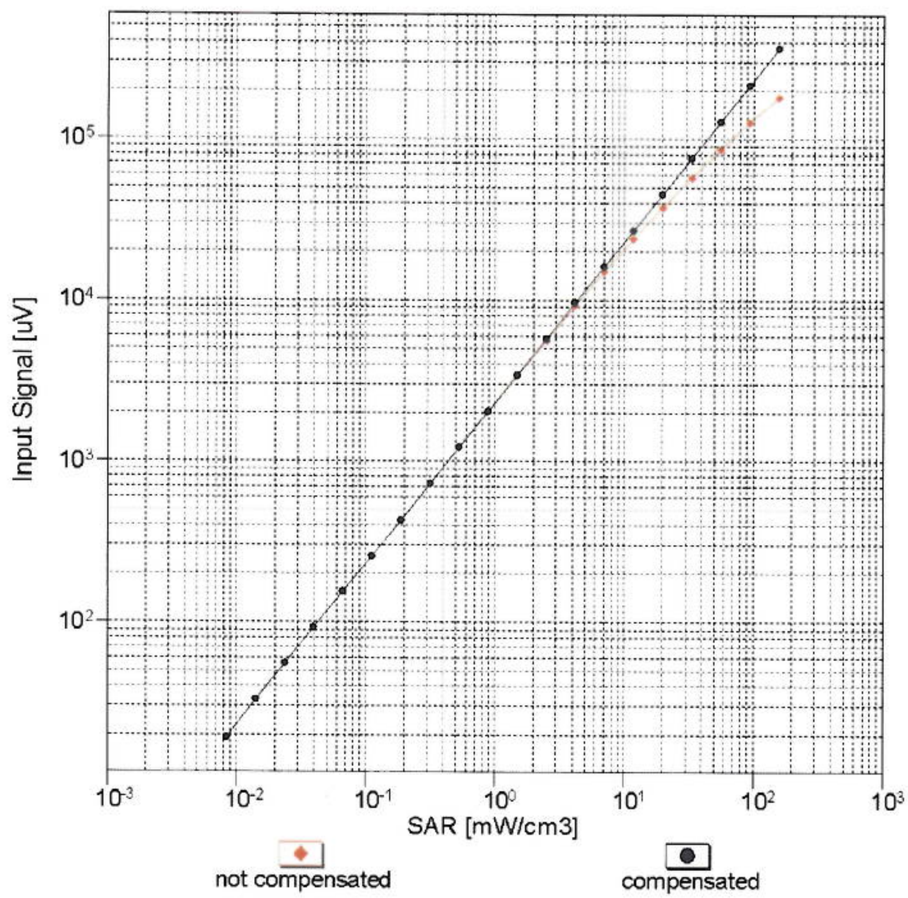
f=1800 MHz,R22

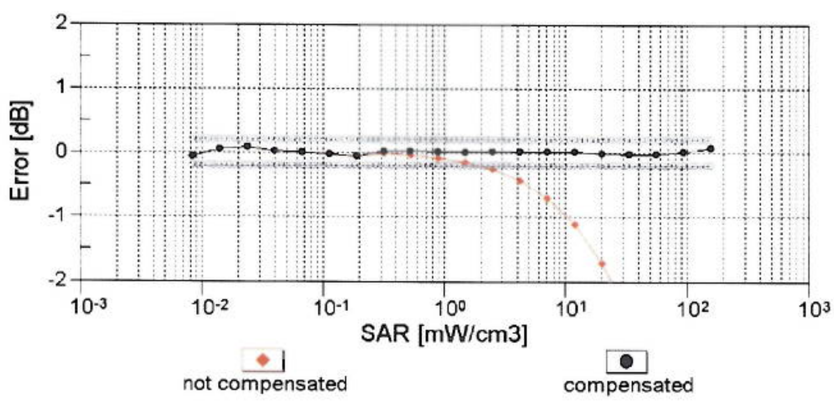




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

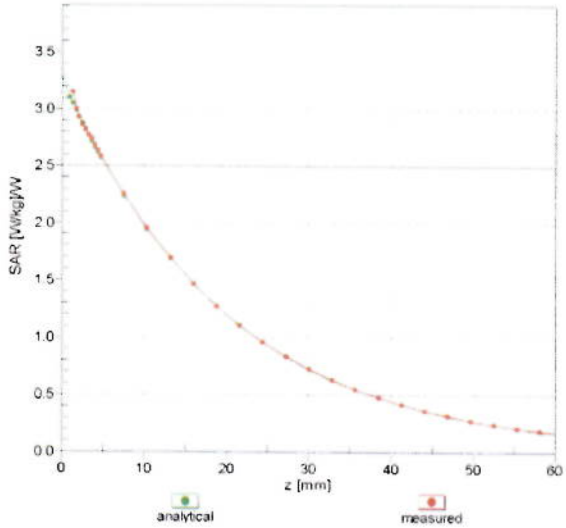




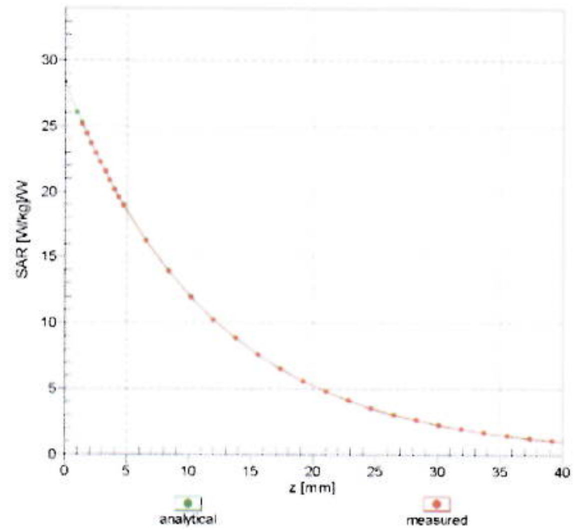
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

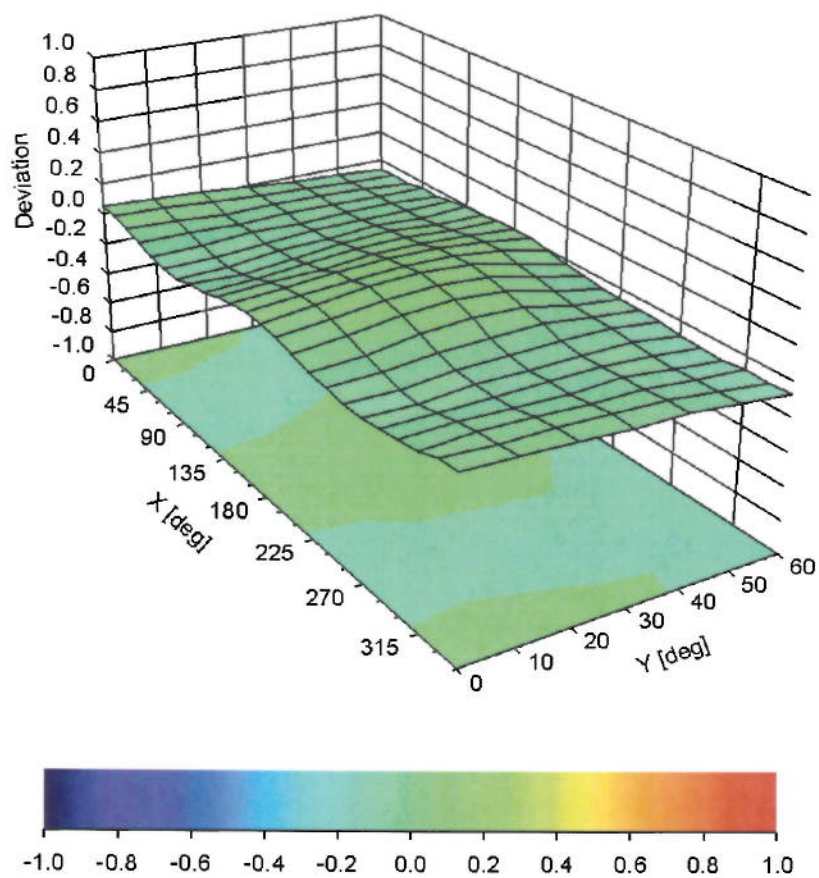


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3988

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-16.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

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**
Swiss Calibration Service

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 0108

Client **Apple**

Certificate No: EX3-3720_Feb15

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3720
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	February 19, 2015

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
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 19, 2015

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

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
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., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *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 *NORMx,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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3720

Manufactured: August 14, 2009
Calibrated: February 19, 2015

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3720

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.50	0.47	0.52	± 10.1 %
DCP (mV)[B]	100.3	106.1	99.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	139.2	±3.0 %
		Y	0.0	0.0	1.0		129.2	
		Z	0.0	0.0	1.0		136.8	
10011-CAB	UMTS-FDD (WCDMA)	X	3.32	67.0	18.4	2.91	148.4	±0.7 %
		Y	3.76	70.8	20.8		139.0	
		Z	3.43	67.6	18.7		148.9	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	2.99	69.4	19.0	1.87	129.1	±1.2 %
		Y	5.24	81.9	25.0		135.9	
		Z	3.00	69.3	19.0		147.2	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.47	69.5	22.6	9.46	141.2	±3.8 %
		Y	10.38	69.3	22.4		149.0	
		Z	10.51	69.5	22.6		137.6	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	2.06	66.9	14.3	9.39	117.3	±2.5 %
		Y	1.22	59.8	9.4		81.4	
		Z	2.33	68.9	15.5		118.1	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	2.21	67.9	15.0	9.57	111.9	±2.2 %
		Y	1.48	62.4	11.2		79.6	
		Z	2.43	69.6	15.9		114.2	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	2.11	69.3	14.0	6.56	148.7	±2.2 %
		Y	1.69	66.7	11.7		148.0	
		Z	1.85	67.7	13.4		130.8	
10030-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH1)	X	1.50	65.2	10.8	5.30	142.7	±1.4 %
		Y	0.97	61.4	8.2		131.9	
		Z	1.58	65.4	10.9		144.9	
10031-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH3)	X	55.99	99.8	19.2	1.87	133.5	±1.7 %
		Y	16.00	84.1	13.5		146.7	
		Z	95.52	99.5	18.3		135.0	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	65.49	99.7	18.4	1.16	141.8	±2.7 %
		Y	0.20	14.0	23.3		130.5	
		Z	95.09	97.5	17.0		142.1	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.61	66.8	19.0	4.57	142.4	±0.9 %
		Y	4.73	68.2	20.0		130.7	
		Z	4.77	67.3	19.2		146.0	
10056-CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	X	4.30	70.3	24.3	11.01	118.7	±1.7 %
		Y	3.86	68.5	23.3		82.6	
		Z	4.47	71.0	24.7		120.1	

10062-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.10	69.0	21.8	8.68	140.7	±3.3 %
		Y	9.88	68.5	21.4		127.5	
		Z	10.20	69.2	21.9		142.6	
10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.86	66.2	18.5	3.97	141.1	±0.7 %
		Y	4.08	68.4	20.0		136.0	
		Z	3.99	66.7	18.8		143.3	
10097-CAB	UMTS-FDD (HSDPA)	X	4.55	66.7	18.6	3.98	132.0	±0.7 %
		Y	4.82	68.6	19.7		127.3	
		Z	4.64	66.9	18.6		134.3	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.56	66.7	18.6	3.98	132.5	±0.9 %
		Y	4.91	69.0	20.0		128.0	
		Z	4.64	66.9	18.7		135.7	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.35	67.1	19.4	5.67	138.7	±1.7 %
		Y	6.31	67.4	19.7		130.8	
		Z	6.44	67.4	19.6		141.7	
10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	7.73	69.0	22.7	9.29	134.2	±1.9 %
		Y	7.27	67.7	21.8		145.4	
		Z	7.91	69.6	23.0		137.1	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.14	66.5	19.3	5.80	135.0	±1.7 %
		Y	6.14	67.0	19.6		129.4	
		Z	6.25	66.9	19.5		137.1	
10110-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	5.82	66.1	19.2	5.75	131.2	±1.4 %
		Y	5.92	67.0	19.7		148.1	
		Z	5.91	66.4	19.3		133.6	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	9.90	68.1	20.8	8.07	127.3	±2.5 %
		Y	10.06	68.7	21.1		140.8	
		Z	10.01	68.3	20.9		129.8	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	7.32	68.5	22.6	9.28	129.3	±1.9 %
		Y	6.94	67.4	21.9		140.9	
		Z	7.47	69.1	22.9		131.8	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	5.80	66.0	19.1	5.75	130.2	±1.4 %
		Y	5.82	66.7	19.6		126.2	
		Z	5.95	66.6	19.4		136.5	
10156-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.59	66.0	19.1	5.79	126.3	±1.4 %
		Y	5.72	67.1	19.8		143.1	
		Z	5.72	66.3	19.3		133.3	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.32	66.9	19.5	5.82	140.0	±1.7 %
		Y	6.24	67.1	19.7		128.4	
		Z	6.37	67.0	19.5		142.0	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	4.77	66.4	19.6	5.73	138.4	±1.2 %
		Y	4.86	67.5	20.3		148.7	
		Z	4.94	67.0	19.9		141.1	
10170-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	5.36	67.0	20.2	6.52	135.9	±1.4 %
		Y	5.41	67.9	20.7		140.8	
		Z	5.58	67.7	20.6		139.2	

10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.77	69.7	23.6	9.21	139.8	±2.2 %
		Y	5.64	69.6	23.3		145.7	
		Z	6.04	70.8	24.2		147.3	
10173-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	6.00	70.5	23.9	9.48	137.9	±1.9 %
		Y	5.97	70.8	24.0		146.3	
		Z	6.28	71.3	24.4		140.6	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.72	66.1	19.4	5.72	132.5	±1.2 %
		Y	4.82	67.3	20.2		145.9	
		Z	4.87	66.6	19.6		135.7	
10176-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.42	67.3	20.3	6.52	131.1	±1.9 %
		Y	5.41	67.9	20.7		141.3	
		Z	5.52	67.5	20.4		133.4	
10177-CAE	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	4.72	66.2	19.4	5.73	131.0	±1.2 %
		Y	4.83	67.4	20.3		141.8	
		Z	4.88	66.7	19.6		135.3	
10178-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.31	66.8	20.1	6.52	130.0	±1.7 %
		Y	5.40	67.8	20.7		140.8	
		Z	5.53	67.5	20.4		133.5	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.69	66.0	19.3	5.72	131.2	±1.2 %
		Y	4.81	67.3	20.2		141.5	
		Z	4.87	66.6	19.6		135.0	
10182-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.36	67.0	20.2	6.52	130.1	±1.4 %
		Y	5.43	68.0	20.8		141.2	
		Z	5.51	67.4	20.4		133.0	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.74	68.6	21.2	8.10	141.0	±3.0 %
		Y	9.59	68.4	21.0		127.1	
		Z	9.91	69.0	21.4		144.9	
10225-CAB	UMTS-FDD (HSPA+)	X	6.97	67.5	19.7	5.97	144.9	±1.7 %
		Y	6.98	68.0	20.0		133.3	
		Z	7.09	67.7	19.8		148.2	
10232-CAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	6.04	70.7	24.1	9.48	138.3	±2.2 %
		Y	5.94	70.6	23.9		145.6	
		Z	6.29	71.4	24.4		141.6	
10234-CAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	5.76	69.6	23.5	9.21	139.6	±2.2 %
		Y	5.69	69.8	23.5		149.6	
		Z	5.97	70.4	23.9		142.0	
10235-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	6.00	70.5	24.0	9.48	137.0	±2.2 %
		Y	5.96	70.7	23.9		147.1	
		Z	6.28	71.3	24.4		140.2	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.77	69.7	23.6	9.21	139.1	±2.2 %
		Y	5.70	69.9	23.6		149.8	
		Z	5.97	70.4	23.9		141.5	
10238-CAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	6.01	70.6	24.0	9.48	137.6	±1.9 %
		Y	5.95	70.6	23.8		147.5	
		Z	6.27	71.3	24.4		139.4	

10240-CAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.78	69.8	23.7	9.21	139.5	±1.9 %
		Y	5.54	69.0	23.1		130.3	
		Z	5.98	70.4	23.9		141.4	
10249-CAB	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	6.69	68.5	22.8	9.29	137.0	±2.2 %
		Y	6.44	67.9	22.3		147.4	
		Z	6.87	69.1	23.1		138.7	
10251-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	8.20	69.0	23.3	10.17	130.5	±2.5 %
		Y	7.87	68.0	22.5		140.0	
		Z	8.36	69.4	23.6		131.2	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.99	68.6	22.7	9.24	143.0	±2.2 %
		Y	6.55	67.1	21.8		133.5	
		Z	7.19	69.4	23.2		145.1	
10255-CAB	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	7.36	69.0	22.8	9.20	149.3	±2.2 %
		Y	6.88	67.4	21.8		142.6	
		Z	7.35	68.8	22.7		128.6	
10264-CAB	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.98	68.6	22.7	9.23	142.6	±2.2 %
		Y	6.54	67.2	21.8		132.8	
		Z	7.19	69.4	23.2		145.0	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	7.48	69.2	23.0	9.30	149.5	±2.2 %
		Y	6.95	67.4	21.9		139.6	
		Z	7.44	68.9	22.8		128.9	
10270-CAB	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	8.03	69.1	22.9	9.58	134.0	±2.2 %
		Y	7.56	67.6	22.0		149.2	
		Z	8.15	69.4	23.1		135.3	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.88	67.1	19.0	4.87	139.6	±1.2 %
		Y	6.08	68.4	19.7		131.0	
		Z	6.02	67.5	19.2		141.8	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.49	67.2	18.9	3.96	146.8	±0.7 %
		Y	4.63	68.6	19.9		135.0	
		Z	4.53	67.2	18.9		148.6	
10290-AAB	CDMA2000, RC1, SO55, Full Rate	X	4.18	67.2	18.9	3.91	140.2	±0.7 %
		Y	4.50	69.8	20.4		149.3	
		Z	4.34	67.7	19.1		140.5	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.61	67.0	18.8	3.46	140.0	±0.7 %
		Y	3.91	69.8	20.5		149.8	
		Z	3.74	67.6	19.0		141.0	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.60	67.4	18.9	3.39	139.9	±0.7 %
		Y	3.99	70.7	20.9		127.5	
		Z	3.70	67.6	19.0		141.0	
10293-AAB	CDMA2000, RC3, SO3, Full Rate	X	3.66	67.2	18.8	3.50	140.6	±0.7 %
		Y	3.96	69.9	20.5		127.4	
		Z	3.79	67.7	19.1		141.5	
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	X	5.44	67.6	24.3	12.49	94.4	±1.2 %
		Y	4.88	64.9	22.4		66.2	
		Z	5.66	68.3	24.6		97.4	

10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.16	66.6	19.4	5.81	131.6	±1.4 %
		Y	6.29	67.5	20.0		149.0	
		Z	6.21	66.7	19.4		132.9	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.77	67.3	19.8	6.06	139.1	±1.9 %
		Y	6.65	67.3	19.8		128.4	
		Z	6.84	67.5	19.9		140.6	
10400-AAB	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.04	69.0	21.6	8.37	143.2	±3.0 %
		Y	9.84	68.6	21.3		130.4	
		Z	10.17	69.2	21.7		145.2	
10401-AAB	IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle)	X	10.48	68.5	21.3	8.60	128.8	±2.7 %
		Y	10.64	69.1	21.6		141.7	
		Z	10.63	68.9	21.5		131.8	
10402-AAB	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	10.76	69.0	21.3	8.53	132.5	±2.7 %
		Y	10.69	69.0	21.3		142.9	
		Z	10.86	69.3	21.5		134.3	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.92	70.2	19.6	3.76	126.4	±0.7 %
		Y	6.00	75.0	21.9		138.3	
		Z	5.21	70.8	19.9		129.6	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.75	69.9	19.5	3.77	126.6	±0.7 %
		Y	5.49	73.4	21.2		139.7	
		Z	5.08	70.7	19.8		149.1	
10406-AAA	CDMA2000, RC3, SO32, SCH0, Full Rate	X	6.04	69.8	20.2	5.22	129.2	±1.2 %
		Y	6.59	72.2	21.4		144.5	
		Z	6.45	70.7	20.6		129.9	
10410-AAA	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	5.37	67.7	21.5	7.82	137.5	±1.9 %
		Y	5.29	67.9	21.7		129.8	
		Z	5.64	68.7	22.1		139.4	

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 E^2-field uncertainty inside TSL (see Pages 9 and 10).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3720

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	8.90	8.90	8.90	0.44	0.92	± 12.0 %
835	41.5	0.90	8.60	8.60	8.60	0.60	0.73	± 12.0 %
900	41.5	0.97	8.59	8.59	8.59	0.78	0.62	± 12.0 %
1450	40.5	1.20	8.10	8.10	8.10	0.25	1.33	± 12.0 %
1750	40.1	1.37	7.58	7.58	7.58	0.70	0.64	± 12.0 %
1900	40.0	1.40	7.40	7.40	7.40	0.80	0.60	± 12.0 %
1950	40.0	1.40	7.04	7.04	7.04	0.51	0.71	± 12.0 %
2000	40.0	1.40	7.20	7.20	7.20	0.57	0.68	± 12.0 %
2300	39.5	1.67	6.90	6.90	6.90	0.43	0.77	± 12.0 %
2450	39.2	1.80	6.62	6.62	6.62	0.50	0.73	± 12.0 %
2600	39.0	1.96	6.41	6.41	6.41	0.42	0.85	± 12.0 %
5200	36.0	4.66	4.95	4.95	4.95	0.30	1.80	± 13.1 %
5300	35.9	4.76	4.77	4.77	4.77	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.67	4.67	4.67	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.38	4.38	4.38	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.37	4.37	4.37	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

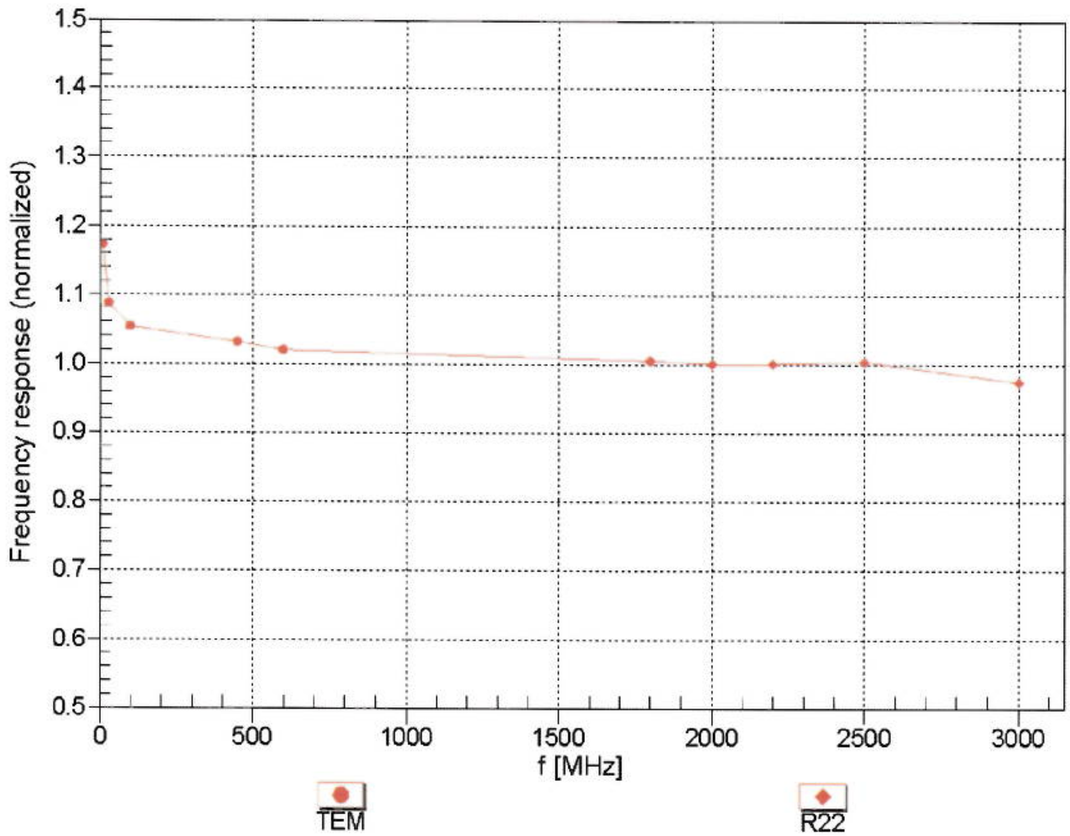
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3720

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	8.69	8.69	8.69	0.44	0.89	± 12.0 %
835	55.2	0.97	8.59	8.59	8.59	0.28	1.17	± 12.0 %
900	55.0	1.05	8.40	8.40	8.40	0.32	1.08	± 12.0 %
1450	54.0	1.30	7.51	7.51	7.51	0.23	1.32	± 12.0 %
1750	53.4	1.49	7.19	7.19	7.19	0.41	0.94	± 12.0 %
1900	53.3	1.52	6.90	6.90	6.90	0.38	0.80	± 12.0 %
1950	53.3	1.52	7.07	7.07	7.07	0.47	0.86	± 12.0 %
2000	53.3	1.52	7.03	7.03	7.03	0.31	1.00	± 12.0 %
2300	52.9	1.81	6.72	6.72	6.72	0.51	0.78	± 12.0 %
2450	52.7	1.95	6.57	6.57	6.57	0.69	0.63	± 12.0 %
2600	52.5	2.16	6.34	6.34	6.34	0.80	0.58	± 12.0 %
5200	49.0	5.30	4.24	4.24	4.24	0.40	1.90	± 13.1 %
5300	48.9	5.42	4.08	4.08	4.08	0.40	1.90	± 13.1 %
5500	48.6	5.65	3.86	3.86	3.86	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.70	3.70	3.70	0.50	1.90	± 13.1 %
5800	48.2	6.00	3.78	3.78	3.78	0.50	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

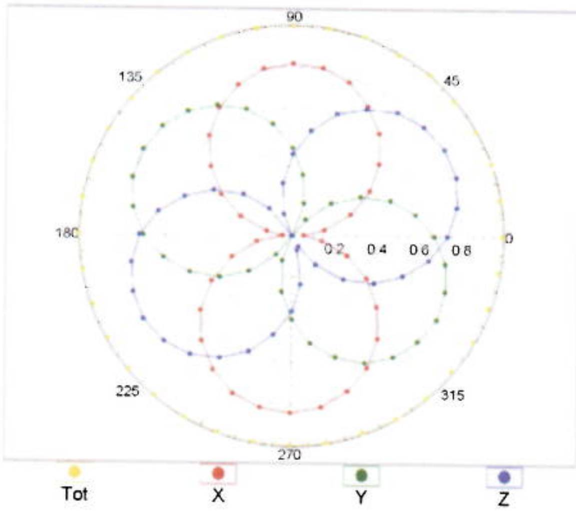
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



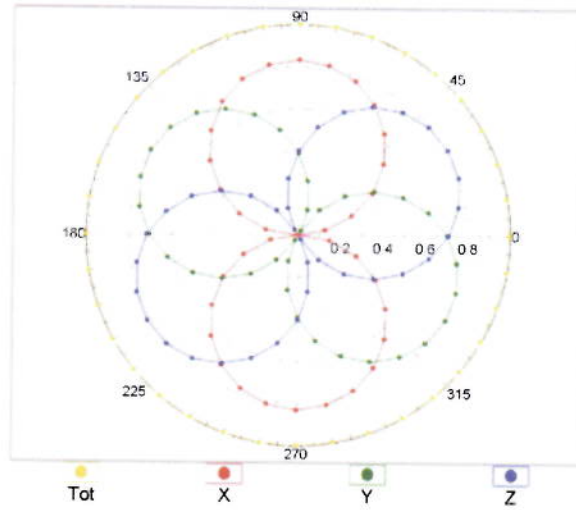
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

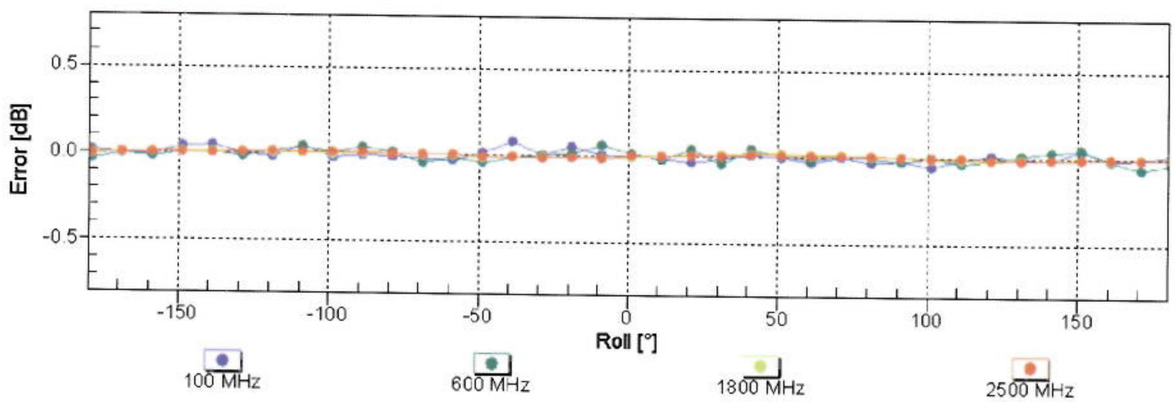
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



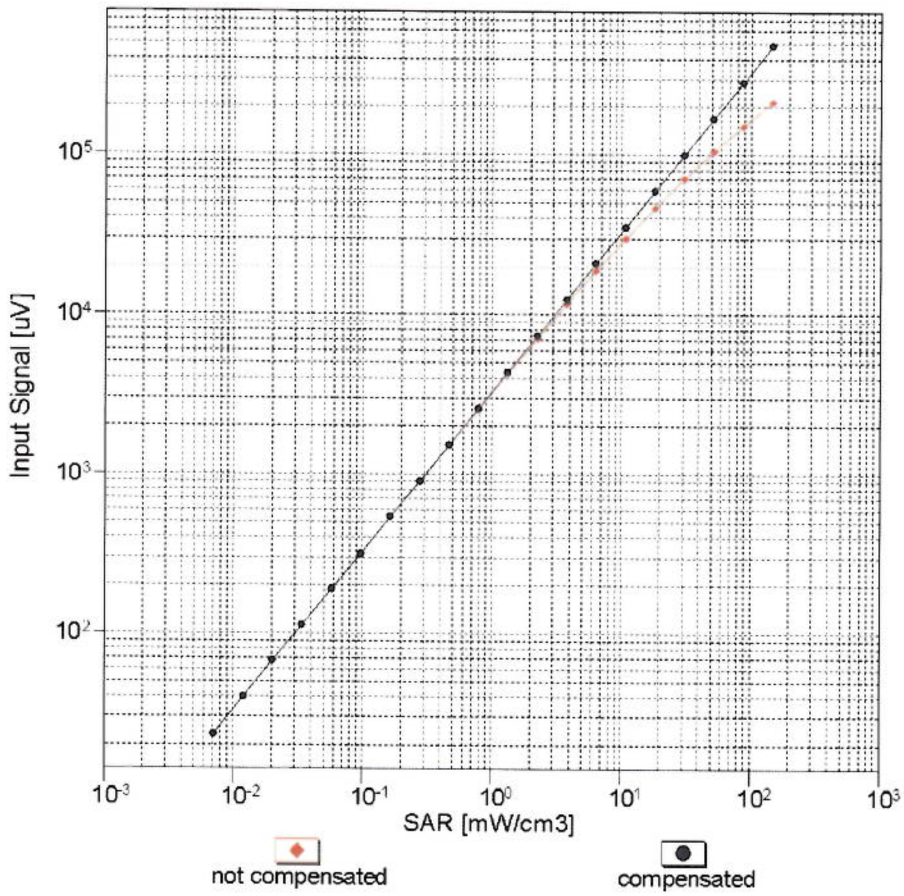
f=1800 MHz,R22

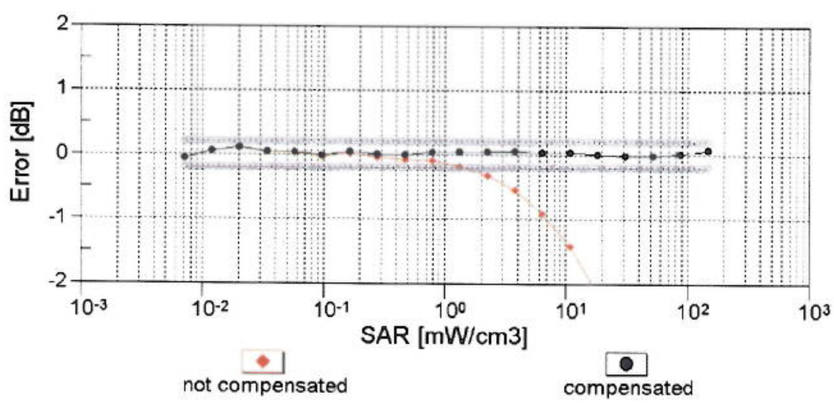




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

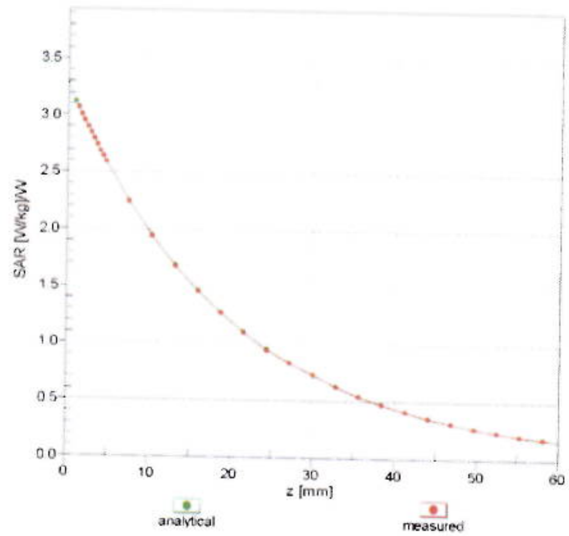




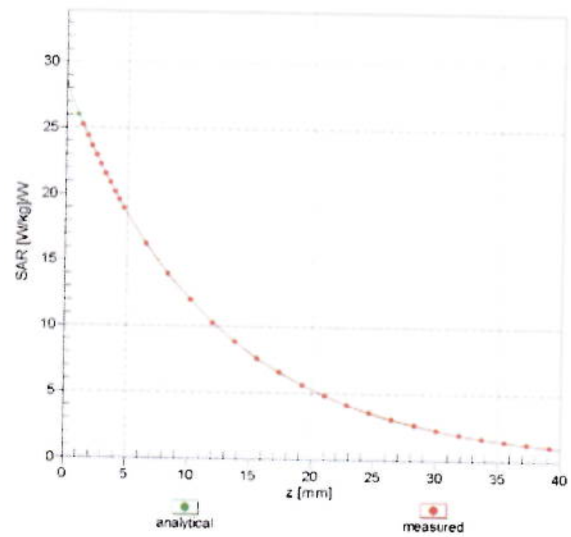
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

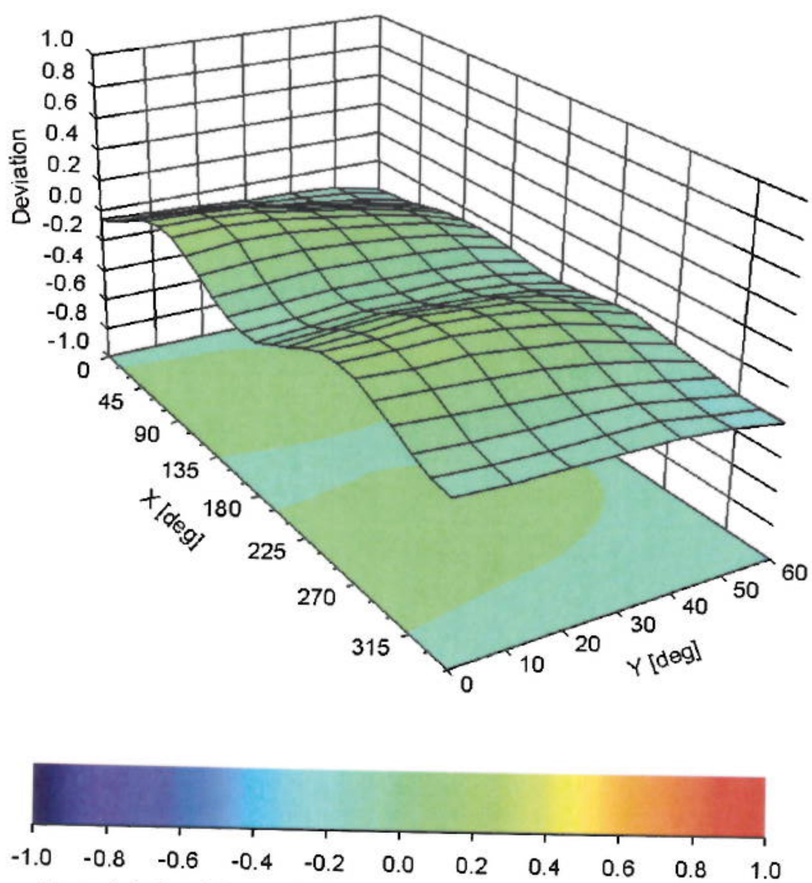


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3720

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-28.8
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

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
Swiss Calibration Service

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 0108

Client Apple

Certificate No: EX3-3993_Feb15

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3993
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	February 19, 2015

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
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 19, 2015

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
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
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 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 *NORMx,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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:3993

Manufactured: January 21, 2014
Calibrated: February 19, 2015

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3993

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.41	0.53	0.52	± 10.1 %
DCP (mV)[B]	96.3	101.1	98.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	133.3	±2.5 %
		Y	0.0	0.0	1.0		128.0	
		Z	0.0	0.0	1.0		137.4	
10011-CAB	UMTS-FDD (WCDMA)	X	3.56	68.2	19.2	2.91	141.7	±0.7 %
		Y	3.40	67.3	18.6		139.0	
		Z	3.27	66.0	17.7		130.6	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.23	70.7	19.9	1.87	140.2	±0.7 %
		Y	3.11	69.9	19.3		138.5	
		Z	2.84	67.6	17.9		129.5	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	10.71	69.4	22.6	9.46	136.2	±3.5 %
		Y	10.62	69.2	22.2		131.2	
		Z	10.97	70.3	23.0		149.0	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	2.06	65.2	13.6	9.39	97.9	±2.2 %
		Y	2.45	67.8	15.3		99.0	
		Z	3.56	73.6	18.1		128.0	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	2.20	65.9	14.0	9.57	95.1	±2.2 %
		Y	2.83	69.7	16.3		97.1	
		Z	3.44	72.9	18.1		121.7	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	2.14	68.0	13.5	6.56	141.8	±2.5 %
		Y	6.77	83.5	20.0		146.9	
		Z	4.19	75.9	17.1		139.1	
10030-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH1)	X	1.52	63.7	10.1	5.30	138.3	±1.4 %
		Y	2.29	68.0	12.5		141.0	
		Z	3.71	73.5	14.9		129.3	
10031-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH3)	X	3.28	74.9	12.7	1.87	149.3	±1.2 %
		Y	53.70	100.0	19.8		128.1	
		Z	63.68	99.7	19.6		139.0	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	97.84	96.1	16.5	1.16	132.8	±1.2 %
		Y	44.90	100.0	19.5		133.8	
		Z	63.70	99.7	19.1		149.8	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.78	67.1	19.3	4.57	134.5	±1.2 %
		Y	4.70	66.6	18.8		135.5	
		Z	4.64	66.1	18.4		128.0	
10056-CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	X	4.41	69.5	23.7	11.01	99.0	±1.4 %
		Y	4.53	69.7	23.6		100.7	
		Z	5.17	73.2	25.7		128.4	

10062-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	10.33	68.9	21.8	8.68	135.5	±3.3 %
		Y	10.28	68.8	21.5		135.1	
		Z	10.48	69.4	22.0		147.5	
10081-CAB	CDMA2000 (1xRTT, RC3)	X	4.04	66.8	19.0	3.97	135.1	±0.7 %
		Y	3.95	66.2	18.5		133.3	
		Z	4.04	66.4	18.5		147.2	
10097-CAB	UMTS-FDD (HSDPA)	X	4.78	67.3	19.0	3.98	126.4	±0.9 %
		Y	4.74	67.1	18.7		149.7	
		Z	4.71	66.7	18.4		138.2	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.79	67.3	19.0	3.98	127.5	±0.9 %
		Y	4.77	67.2	18.8		149.9	
		Z	4.70	66.7	18.4		140.9	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.51	67.3	19.7	5.67	131.1	±1.7 %
		Y	6.39	67.0	19.4		128.7	
		Z	6.59	67.6	19.7		147.2	
10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	7.88	68.8	22.5	9.29	128.7	±2.5 %
		Y	7.92	68.8	22.3		129.8	
		Z	8.54	70.9	23.6		148.7	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.34	66.8	19.6	5.80	128.8	±1.9 %
		Y	6.23	66.5	19.2		126.4	
		Z	6.35	66.9	19.4		139.6	
10110-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.15	67.0	19.7	5.75	147.7	±1.7 %
		Y	6.05	66.6	19.3		146.6	
		Z	6.04	66.5	19.3		139.3	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.52	69.2	21.4	8.07	146.3	±3.0 %
		Y	10.31	68.8	21.1		141.9	
		Z	10.22	68.6	21.0		135.1	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	7.61	68.8	22.7	9.28	145.6	±2.5 %
		Y	7.73	69.1	22.6		147.2	
		Z	8.03	70.2	23.4		142.1	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.18	67.1	19.8	5.75	149.8	±1.7 %
		Y	6.12	66.9	19.5		147.7	
		Z	6.00	66.3	19.2		134.3	
10156-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	5.93	66.9	19.7	5.79	148.4	±1.7 %
		Y	5.80	66.3	19.2		141.0	
		Z	5.75	66.0	19.0		132.4	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.43	66.8	19.6	5.82	128.8	±1.9 %
		Y	6.35	66.6	19.3		127.9	
		Z	6.50	67.0	19.4		144.9	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.00	67.2	20.1	5.73	149.6	±1.2 %
		Y	5.03	67.0	19.7		149.4	
		Z	4.99	66.7	19.5		142.1	
10170-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	5.61	67.7	20.6	6.52	147.0	±1.7 %
		Y	5.74	67.9	20.5		146.8	
		Z	5.67	67.5	20.3		137.4	

10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.94	69.9	23.6	9.21	136.3	±2.7 %
		Y	6.13	70.1	23.4		134.1	
		Z	6.47	71.7	24.4		148.2	
10173-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	6.19	70.6	23.9	9.48	131.2	±2.5 %
		Y	6.41	70.7	23.7		134.4	
		Z	6.76	72.5	24.8		145.2	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.83	66.4	19.6	5.72	126.2	±1.2 %
		Y	5.03	67.0	19.7		149.2	
		Z	4.94	66.5	19.4		135.5	
10176-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.49	67.3	20.4	6.52	126.9	±1.7 %
		Y	5.75	68.0	20.6		146.2	
		Z	5.63	67.4	20.2		134.3	
10177-CAE	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	4.86	66.6	19.7	5.73	128.6	±1.2 %
		Y	4.99	66.8	19.6		145.7	
		Z	4.94	66.4	19.4		138.0	
10178-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.46	67.1	20.3	6.52	127.8	±1.7 %
		Y	5.71	67.7	20.4		145.1	
		Z	5.64	67.4	20.2		137.1	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	4.85	66.5	19.7	5.72	128.2	±1.4 %
		Y	5.01	66.9	19.7		146.5	
		Z	4.96	66.5	19.4		140.3	
10182-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.47	67.2	20.3	6.52	127.1	±1.7 %
		Y	5.70	67.6	20.3		145.7	
		Z	5.64	67.4	20.3		136.6	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.06	68.9	21.4	8.10	140.8	±3.0 %
		Y	9.86	68.4	21.0		132.3	
		Z	9.67	67.9	20.8		123.5	
10225-CAB	UMTS-FDD (HSPA+)	X	7.15	67.5	19.8	5.97	143.6	±1.4 %
		Y	7.08	67.3	19.5		136.3	
		Z	6.95	66.8	19.3		130.6	
10232-CAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	6.22	70.8	24.0	9.48	136.0	±2.5 %
		Y	6.44	70.8	23.8		135.7	
		Z	6.53	71.4	24.3		129.6	
10234-CAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	5.91	69.7	23.4	9.21	132.7	±2.7 %
		Y	6.11	69.9	23.3		134.7	
		Z	6.45	71.5	24.4		149.3	
10235-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	6.16	70.4	23.8	9.48	131.0	±2.7 %
		Y	6.41	70.7	23.7		133.5	
		Z	6.78	72.5	24.9		148.6	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.91	69.7	23.5	9.21	133.0	±2.5 %
		Y	6.11	69.9	23.3		135.7	
		Z	6.11	69.9	23.4		127.5	
10238-CAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	6.15	70.4	23.8	9.48	131.2	±2.5 %
		Y	6.38	70.6	23.6		133.4	
		Z	6.74	72.3	24.8		148.2	

10240-CAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.90	69.7	23.4	9.21	133.5	±2.7 %
		Y	6.10	69.8	23.3		137.6	
		Z	6.48	71.7	24.5		149.4	
10249-CAB	LTE-TDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	6.81	68.2	22.6	9.29	131.7	±2.7 %
		Y	6.92	68.4	22.4		134.1	
		Z	7.37	70.1	23.6		148.0	
10251-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	8.46	69.1	23.4	10.17	146.1	±2.7 %
		Y	8.38	68.5	22.8		127.0	
		Z	8.81	70.2	23.9		139.4	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	7.12	68.4	22.6	9.24	137.6	±2.7 %
		Y	7.24	68.6	22.5		140.2	
		Z	7.42	69.3	22.9		129.9	
10255-CAB	LTE-TDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	7.48	68.6	22.5	9.20	144.1	±2.7 %
		Y	7.64	69.0	22.6		147.2	
		Z	7.86	69.7	23.0		136.0	
10264-CAB	LTE-TDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	7.12	68.4	22.6	9.23	137.6	±2.5 %
		Y	7.25	68.6	22.5		140.3	
		Z	7.41	69.2	22.9		129.7	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	7.59	68.7	22.6	9.30	144.4	±2.5 %
		Y	7.73	69.1	22.6		146.4	
		Z	7.99	70.0	23.3		136.9	
10270-CAB	LTE-TDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	8.11	68.6	22.6	9.58	129.8	±2.5 %
		Y	8.25	68.9	22.5		131.7	
		Z	8.77	70.7	23.6		146.6	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	6.07	67.3	19.2	4.87	134.1	±1.2 %
		Y	6.01	67.0	18.9		133.1	
		Z	6.13	67.3	19.0		149.1	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.64	67.4	19.1	3.96	143.1	±0.9 %
		Y	4.47	66.7	18.6		137.9	
		Z	4.45	66.3	18.4		129.6	
10290-AAB	CDMA2000, RC1, SO55, Full Rate	X	4.40	67.8	19.2	3.91	135.7	±0.9 %
		Y	4.35	67.5	18.9		133.3	
		Z	4.41	67.4	18.8		148.2	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.75	67.5	19.0	3.46	135.4	±0.7 %
		Y	3.71	67.2	18.8		134.2	
		Z	3.71	66.7	18.4		147.7	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.77	68.0	19.3	3.39	135.6	±0.7 %
		Y	3.63	67.1	18.7		132.0	
		Z	3.70	67.0	18.5		148.0	
10293-AAB	CDMA2000, RC3, SO3, Full Rate	X	3.78	67.5	19.1	3.50	135.8	±0.7 %
		Y	3.74	67.2	18.8		131.4	
		Z	3.79	67.1	18.6		148.5	
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	X	5.40	66.2	23.3	12.49	79.8	±1.4 %
		Y	5.59	66.7	23.4		81.1	
		Z	6.27	70.1	25.6		104.2	

10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.28	66.6	19.4	5.81	126.5	±1.7 %
		Y	6.41	67.2	19.6		147.5	
		Z	6.37	66.9	19.5		135.9	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.89	67.2	19.8	6.06	132.5	±1.9 %
		Y	6.77	67.0	19.5		128.0	
		Z	6.99	67.6	19.8		144.7	
10400-AAB	IEEE 802.11ac WiFi (20MHz, 64-QAM, 99pc duty cycle)	X	10.24	68.9	21.6	8.37	138.1	±3.3 %
		Y	10.15	68.7	21.3		133.7	
		Z	9.96	68.3	21.1		124.7	
10401-AAB	IEEE 802.11ac WiFi (40MHz, 64-QAM, 99pc duty cycle)	X	10.62	68.4	21.3	8.60	122.3	±3.3 %
		Y	10.91	69.3	21.6		143.5	
		Z	10.83	69.1	21.5		135.3	
10402-AAB	IEEE 802.11ac WiFi (80MHz, 64-QAM, 99pc duty cycle)	X	10.88	68.8	21.3	8.53	125.1	±3.3 %
		Y	10.99	69.4	21.5		145.4	
		Z	11.04	69.4	21.5		138.0	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	5.16	70.6	19.8	3.76	142.7	±0.5 %
		Y	5.09	69.8	19.3		141.4	
		Z	5.02	69.4	19.1		132.4	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	5.15	70.9	20.1	3.77	140.5	±0.9 %
		Y	4.94	69.6	19.2		137.7	
		Z	4.94	69.4	19.2		132.7	
10406-AAA	CDMA2000, RC3, SO32, SCH0, Full Rate	X	6.45	70.5	20.6	5.22	144.6	±0.9 %
		Y	6.58	70.4	20.4		144.2	
		Z	6.48	70.1	20.3		138.4	
10410-AAA	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK, UL Subframe=2,3,4,7,8,9)	X	5.48	67.7	21.5	7.82	129.5	±1.9 %
		Y	5.65	68.0	21.4		129.1	
		Z	5.93	69.3	22.3		146.2	

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 E^2-field uncertainty inside TSL (see Pages 9 and 10).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3993

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	10.44	10.44	10.44	0.35	1.01	± 12.0 %
835	41.5	0.90	9.99	9.99	9.99	0.32	1.02	± 12.0 %
900	41.5	0.97	9.92	9.92	9.92	0.80	0.63	± 12.0 %
1450	40.5	1.20	8.93	8.93	8.93	0.47	0.75	± 12.0 %
1750	40.1	1.37	8.48	8.48	8.48	0.34	0.82	± 12.0 %
1900	40.0	1.40	8.28	8.28	8.28	0.31	0.88	± 12.0 %
1950	40.0	1.40	7.98	7.98	7.98	0.23	0.99	± 12.0 %
2000	40.0	1.40	8.17	8.17	8.17	0.66	0.58	± 12.0 %
2300	39.5	1.67	7.77	7.77	7.77	0.53	0.71	± 12.0 %
2450	39.2	1.80	7.51	7.51	7.51	0.39	0.78	± 12.0 %
2600	39.0	1.96	7.19	7.19	7.19	0.28	1.05	± 12.0 %
5200	36.0	4.66	5.46	5.46	5.46	0.30	1.80	± 13.1 %
5300	35.9	4.76	5.20	5.20	5.20	0.30	1.80	± 13.1 %
5500	35.6	4.96	5.14	5.14	5.14	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.93	4.93	4.93	0.35	1.80	± 13.1 %
5800	35.3	5.27	4.82	4.82	4.82	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3993

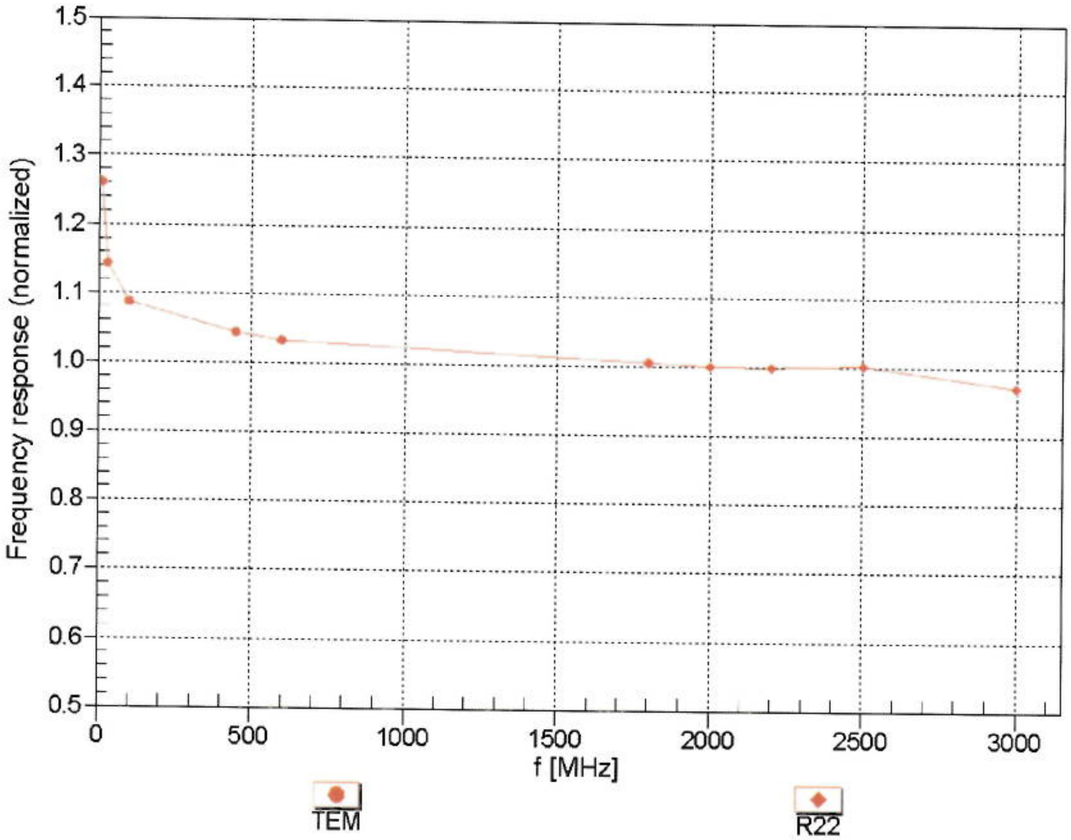
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	10.12	10.12	10.12	0.22	1.41	± 12.0 %
835	55.2	0.97	9.97	9.97	9.97	0.18	1.71	± 12.0 %
900	55.0	1.05	9.82	9.82	9.82	0.36	0.94	± 12.0 %
1450	54.0	1.30	8.67	8.67	8.67	0.40	1.00	± 12.0 %
1750	53.4	1.49	8.33	8.33	8.33	0.41	0.88	± 12.0 %
1900	53.3	1.52	7.95	7.95	7.95	0.38	0.82	± 12.0 %
1950	53.3	1.52	8.06	8.06	8.06	0.26	1.11	± 12.0 %
2000	53.3	1.52	7.92	7.92	7.92	0.36	0.91	± 12.0 %
2300	52.9	1.81	7.53	7.53	7.53	0.51	0.72	± 12.0 %
2450	52.7	1.95	7.42	7.42	7.42	0.50	0.73	± 12.0 %
2600	52.5	2.16	7.09	7.09	7.09	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.88	4.88	4.88	0.40	1.90	± 13.1 %
5300	48.9	5.42	4.67	4.67	4.67	0.40	1.90	± 13.1 %
5500	48.6	5.65	4.27	4.27	4.27	0.50	1.90	± 13.1 %
5600	48.5	5.77	4.10	4.10	4.10	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.37	4.37	4.37	0.50	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

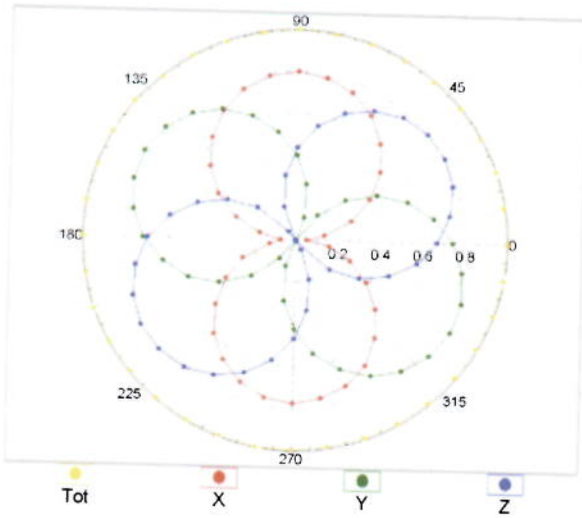
(TEM-Cell:ifi110 EXX, Waveguide: R22)



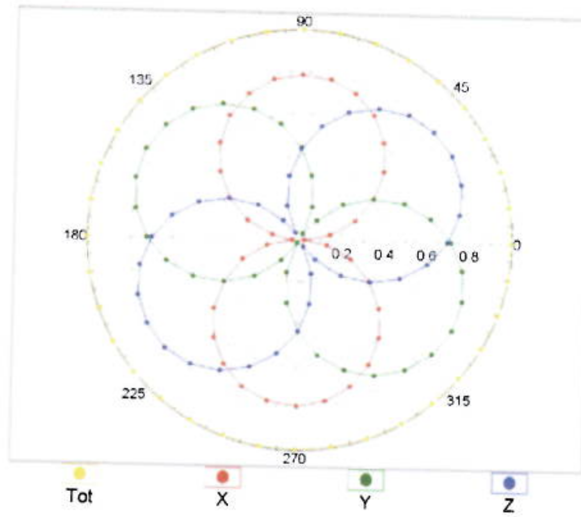
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

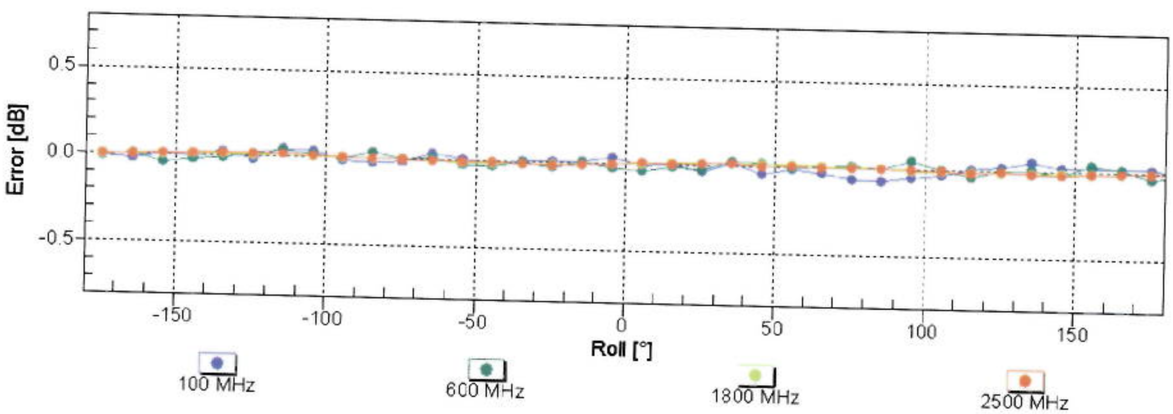
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



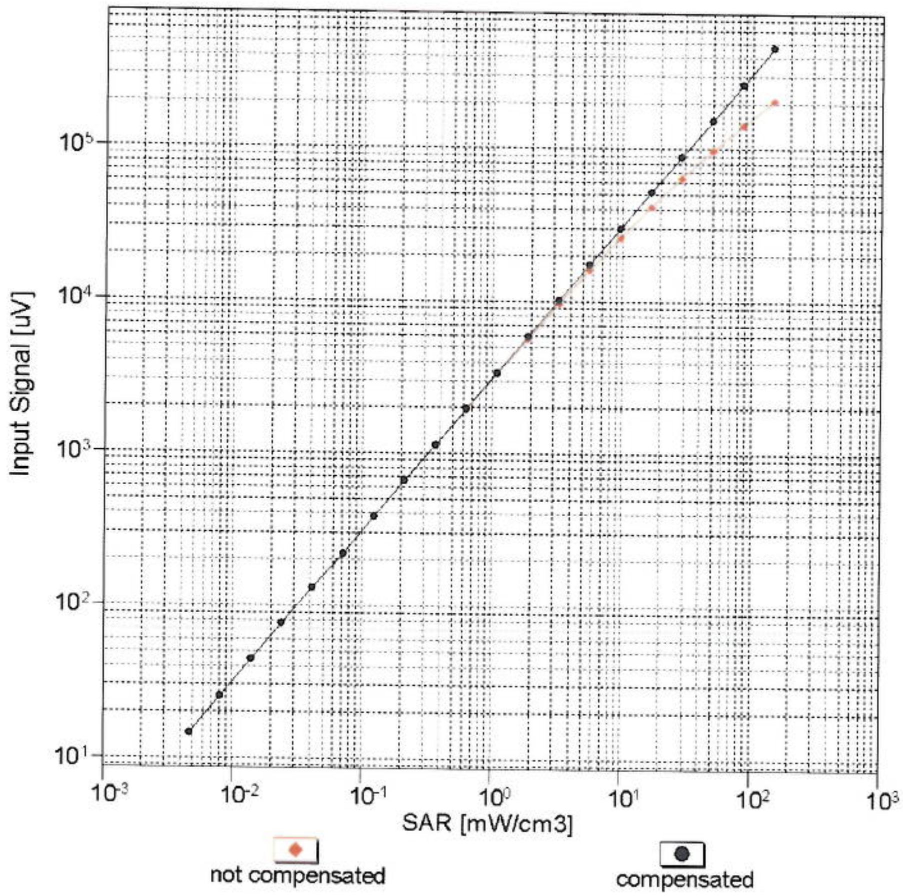
f=1800 MHz,R22

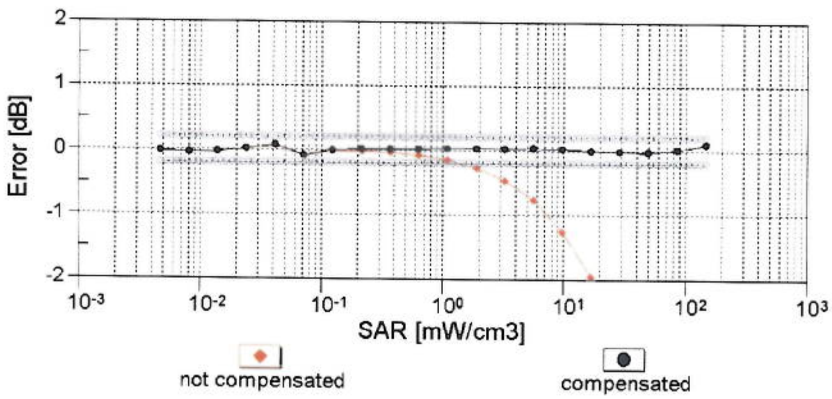




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR$_{head}$)
(TEM cell , f_{eval}= 1900 MHz)

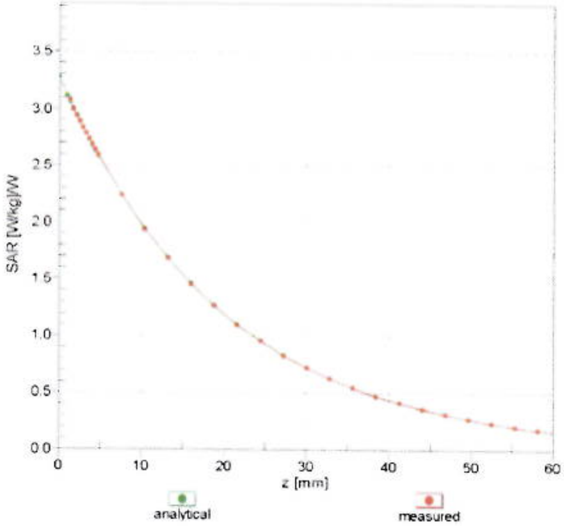




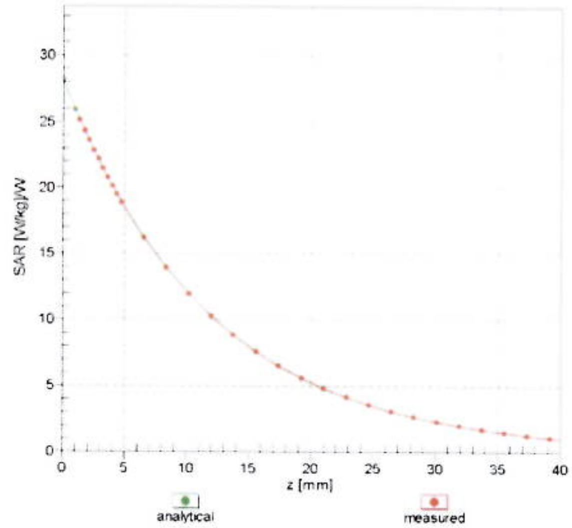
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

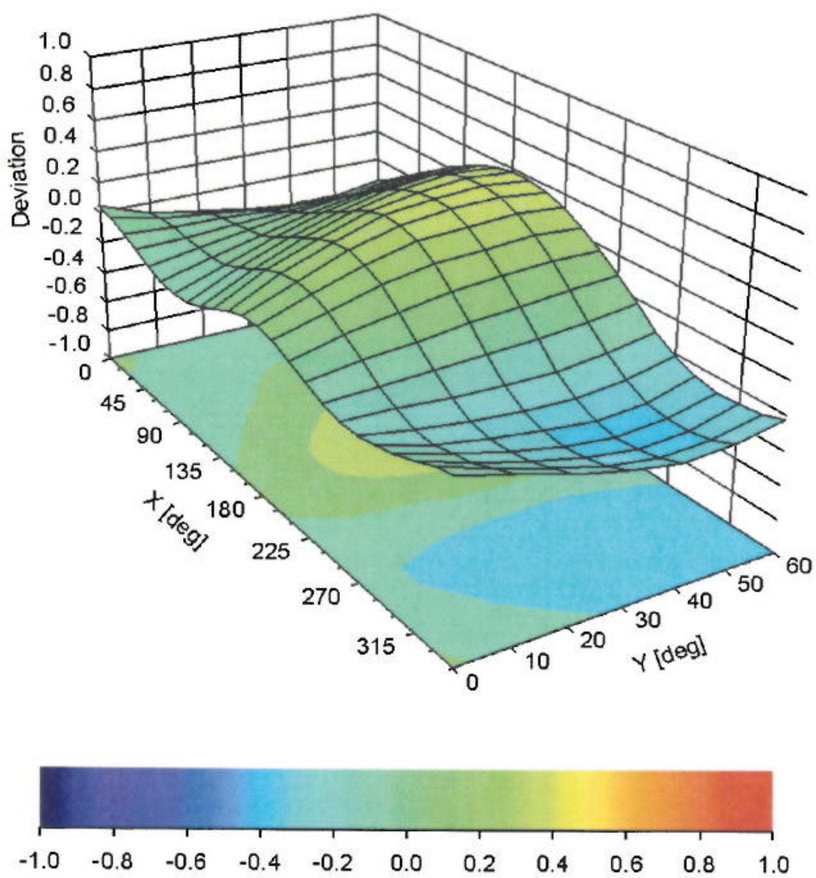


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3993

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-104.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm