DIPOLE 835 MHZ CALIBRATION REPORT

Prepared By: LUC Jérôme, SATIMO

Project Description: SAR TEST BENCH

Prepared For (End User): Shenzhen Morlab Communication Technology

DIPOLE 835 MHz CALIBRATION REPORT

DATE: 19/02/2009

REFERENCE: SN 36/08 DIPC99

OBJECT: COMOSAR IEEE REFERENCE DIPOLE

MANUFACTURER: SATIMO

SERIAL NUMBER: SN 36/08 DIPC99

CUSTOMER: Shenzhen Morlab Communication Technology

CONTRACT: PF2130108b_SAR_Morlab

DATE OF CALIBRATION: 23/09/2009

WARRANTY:

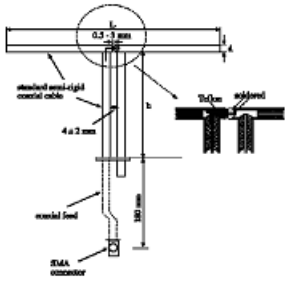
Date

2009/10/05

SAR TEAM MANAGER

SATIMO Bretagne
Technopôle Brest Iroise
Zone du Vernis
225 rue Pierre Rivoalon
29200 BREST

PRODUCT DESCRIPTION



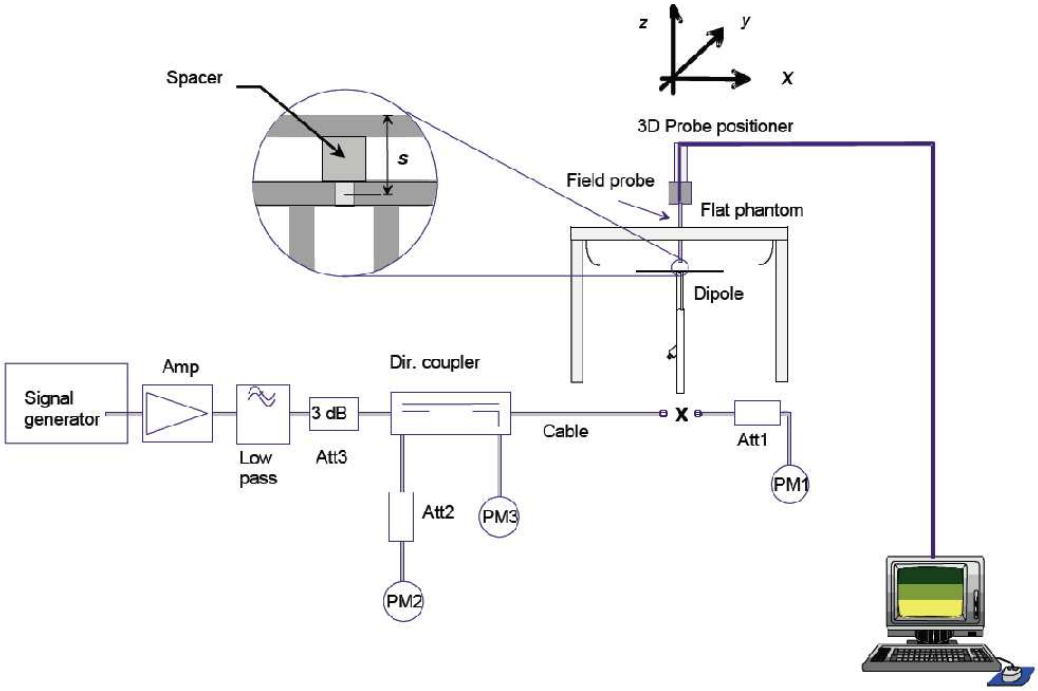
Dimension: L=161 mm/ h=89.8mm / d=3.6 mm

CALIBRATION TEST EQUIPMENT

TYPE	IDENTIFICATION	DATE OF CALIBRATION
Vector Network Analyzer	HP8753D (SN: 5410A08882)	10-05-2009

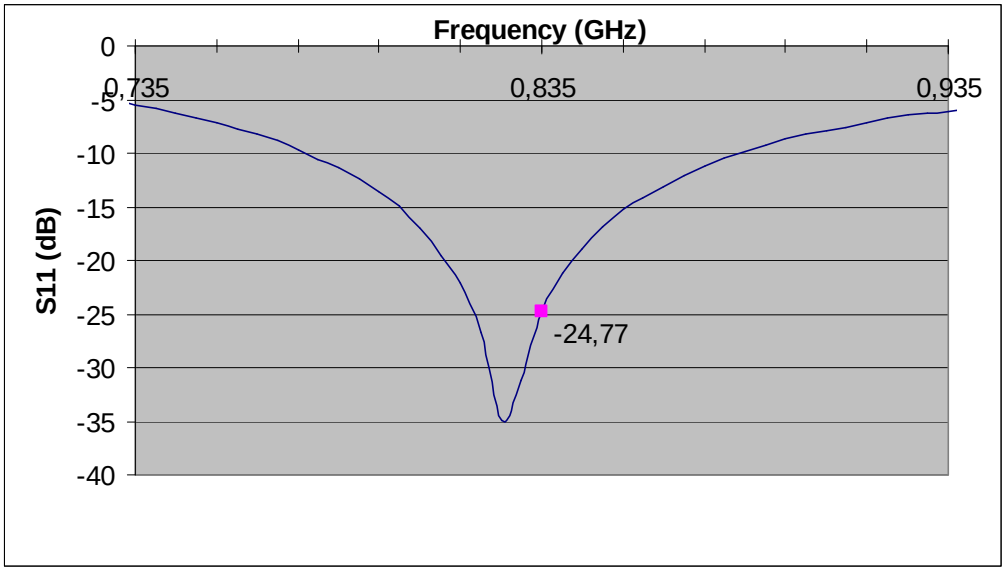
MEASUREMENT PROCEDURE

We placed the dipole under the flat part of SAM phantom fill with 835 MHz head liquid.



Calibration was performed according to IEEE Std P1528-2003 and OET bulletin 65 Supplement C (Ed. 01-01)

VSWR at 835 MHz: -24.77 dB.



SAR MEASUREMENT EQUIPEMENT

Voltmeter	Keithley (2000, SN:1000572)	Date of calibration: 01-07-2009
Signal generator	Rohde&Schwarz (SML_03, SN:101868)	Date of calibration: 15-11-2008
Power amplifier	Nuclétudes (ALB216, SN:10800)	Date of calibration: 24-10-2008
Power meter	Rohde&Schwarz (NRVD, SN:101066)	Date of calibration: 04-07-2009
Probe	SATIMO Bretagne (SN:EP37) CF (30.41,29.18,32.33)	Date of calibration: 19-06-2009

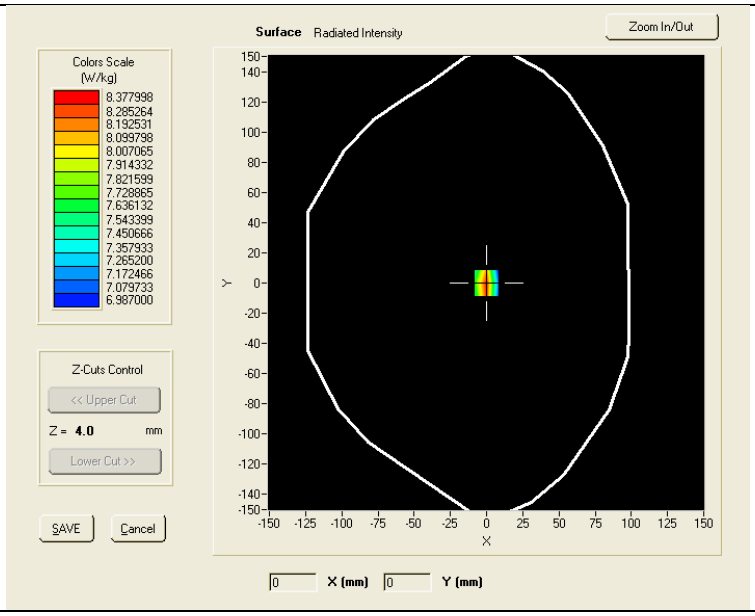
SAR MEASUREMENT CONDITION

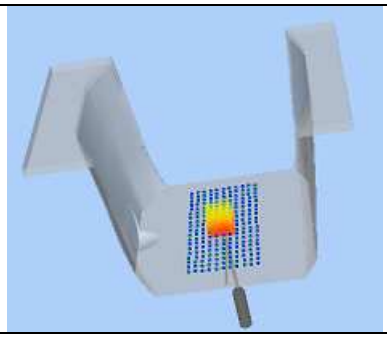
Software	OpenSAR V3
Phantom	SATIMO Bretagne (SN: SN_20_07_SAM42)
Liquid	SATIMO Bretagne (Last Calibration: 18 09 08) Head Liquid Values: eps' : 41,20 sigma : 0,872
Distance between the center of the dipole and the liquid (set with a spacer)	15 mm
Area scan resolution	dx=8mm/dy=8mm
Zoom scan resolution	dx=8mm/dy=8m/dz=5mm
Frequency	835 MHz
Input power	30 dBm
Expanded uncertainty (K=1)	8.09%

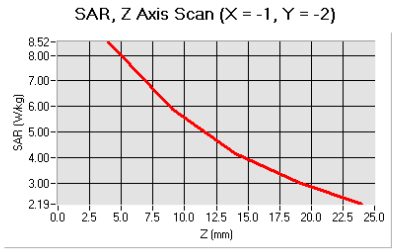
SAR MEASUREMENT RESULT

	10g	1g
SAR measured Liquid : HL Input power : 1W	**6,364 W/Kg** **+ 2,64 %**	**9,805 W/Kg** **+ 3,21 %**

SAR MEASUREMENT PLOTS







DIPOLE 1800 MHZ CALIBRATION REPORT

Prepared By:	LUC Jérôme, SATIMO
Project Description:	SAR TEST BENCH
Prepared For (End User):	Shenzhen Morlab Communication Technology

DIPOLE 1800 MHz CALIBRATION REPORT

DATE: 19/02/2009

REFERENCE: SN 36/08 DIPF101

OBJECT: COMOSAR IEEE REFERENCE DIPOLE

MANUFACTURER: SATIMO

SERIAL NUMBER: SN 36/08 DIPF101

CUSTOMER: Shenzhen Morlab Communication Technology

CONTRACT: PF2130108b_SAR_Morlab

DATE OF CALIBRATION: 23/09/2009

WARRANTY:

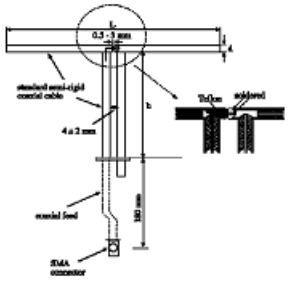
Date

2009/10/05

SATIMO Bretagne
Technopôle Brest Iroise
Zone du Vernis
225 rue Pierre Rivoalon
29200 BREST

SAR TEAM MANAGER

PRODUCT DESCRIPTION



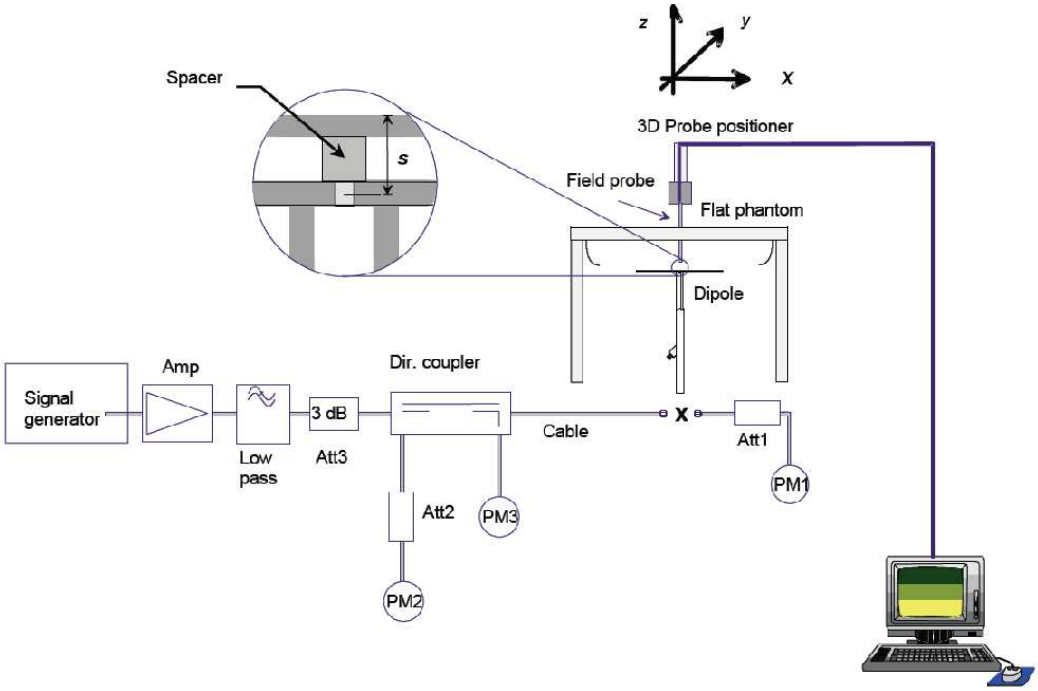
Dimension: L=72 mm/ h=41.7 mm / d=3.6 mm

CALIBRATION TEST EQUIPMENT

TYPE	IDENTIFICATION	DATE OF CALIBRATION
Vector Network Analyzer	HP8753D (SN: 5410A08882)	10-05-2009

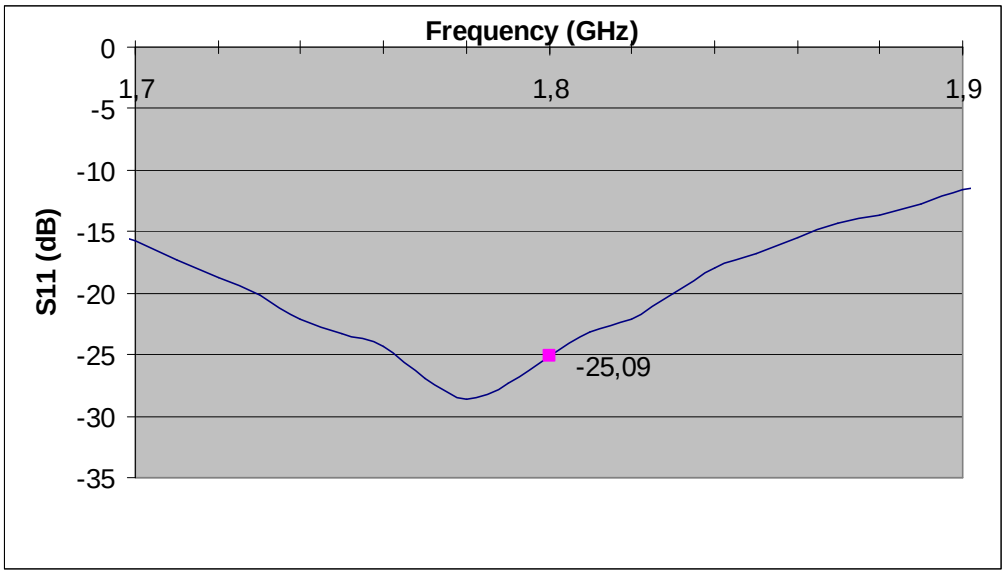
MEASUREMENT PROCEDURE

We placed the dipole under the flat part of SAM phantom fill with 1800 MHz head liquid.



Calibration was performed according to IEEE Std P1528-2003 and OET bulletin 65 Supplement C (Ed. 01-01)

VSWR at 1800 MHz: -25.09 dB



SAR MEASUREMENT EQUIPEMENT

Voltmeter	Keithley (2000, SN:1000572)	Date of calibration: 01-07-2009
Signal generator	Rohde&Schwarz (SML_03, SN:101868)	Date of calibration: 15-11-2008
Power amplifier	Nuclétudes (ALB216, SN:10800)	Date of calibration: 24-10-2008
Power meter	Rohde&Schwarz (NRVD, SN:101066)	Date of calibration: 04-07-2009
Probe	SATIMO Bretagne (SN:EP37) CF (35.35,34.93,37.42)	Date of calibration: 19-06-2009

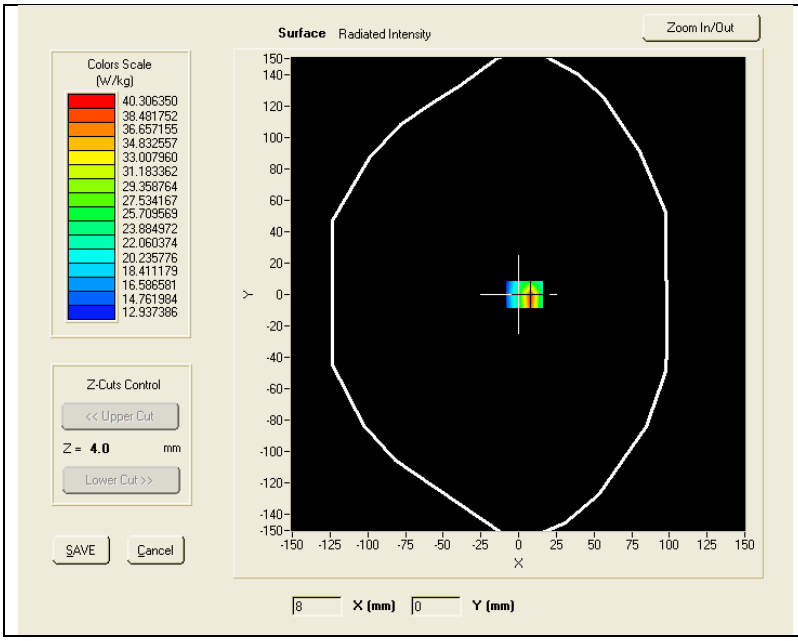
SAR MEASUREMENT CONDITION

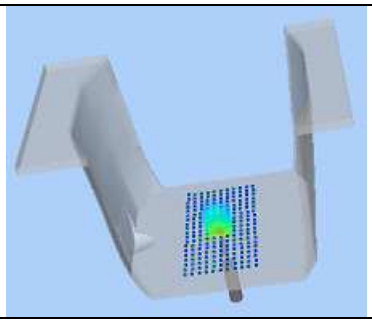
Software	OpenSAR V3
Phantom	SATIMO Bretagne (SN: SN_20_07_SAM42)
Liquid	SATIMO Bretagne (Last Calibration: 19 09 08) Head Liquid Values: eps' : 39,80 sigma : 1,45
Distance between the center of the dipole and the liquid (set with a spacer)	10 mm
Area scan resolution	dx=8mm/dy=8mm
Zoom scan resolution	dx=8mm/dy=8m/dz=5mm
Frequency	1800 MHz
Input power	30 dBm
Expanded uncertainty (K=1)	8.09%

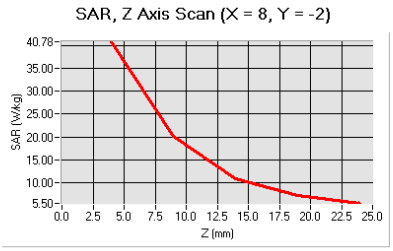
SAR MEASUREMENT RESULT

	10g	1g
SAR measured Liquid : HL Input power : 1W	**20,05 W/Kg** **+ 1,24 %**	**39,32 W/Kg** **+ 3,20 %**

SAR MEASUREMENT PLOTS







COMOSAR E-FIELD PROBE CALIBRATION REPORT

Prepared By: LUC Jérôme, SATIMO

Project Description: SAR TEST BENCH

Prepared For (End User): Shenzhen Morlab Communication Technology

COMOSAR SEPT ISOTROPIC E-FIELD PROBE CALIBRATION REPORT

DATE: 12/02/2009

REFERENCE: SN 37/08 EP80

OBJECT: COMOSAR SEPT ISOTROPIC E-FIELD PROBE

MANUFACTURER: SATIMO

SERIAL NUMBER: SN 37/08 EP80

CUSTOMER: Shenzhen Morlab Communication Technology

CONTRACT: PF2130108b_SAR_Morlab

DATE OF CALIBRATION: 24/09/2009

WARRANTY:

Date

2009/10/05

SATIMO Bretagne
Technopôle Brest Iroise
Zone du Vernis
225 rue Pierre Rivoalon
29200 BREST

SAR TEAM MANAGER

PRODUCT DESCRIPTION

Frequency Range	100 MHz - 30 GHz
Probe length	330 mm
Length of one dipole	4.5 mm
Maximum external diameter	8 mm
Probe extremity diameter	6.5 mm
Distance between dipoles/probe extremity	< 2.7 mm
Resistance of the three dipole (at the connector)	Dipole 1: R1=1.4382 MΩ Dipole 2: R2=1.4894 MΩ Dipole 3: R3=1.4683 MΩ
Connector (HIROSE series SR30)	6 wire male (Hirose SR30series)

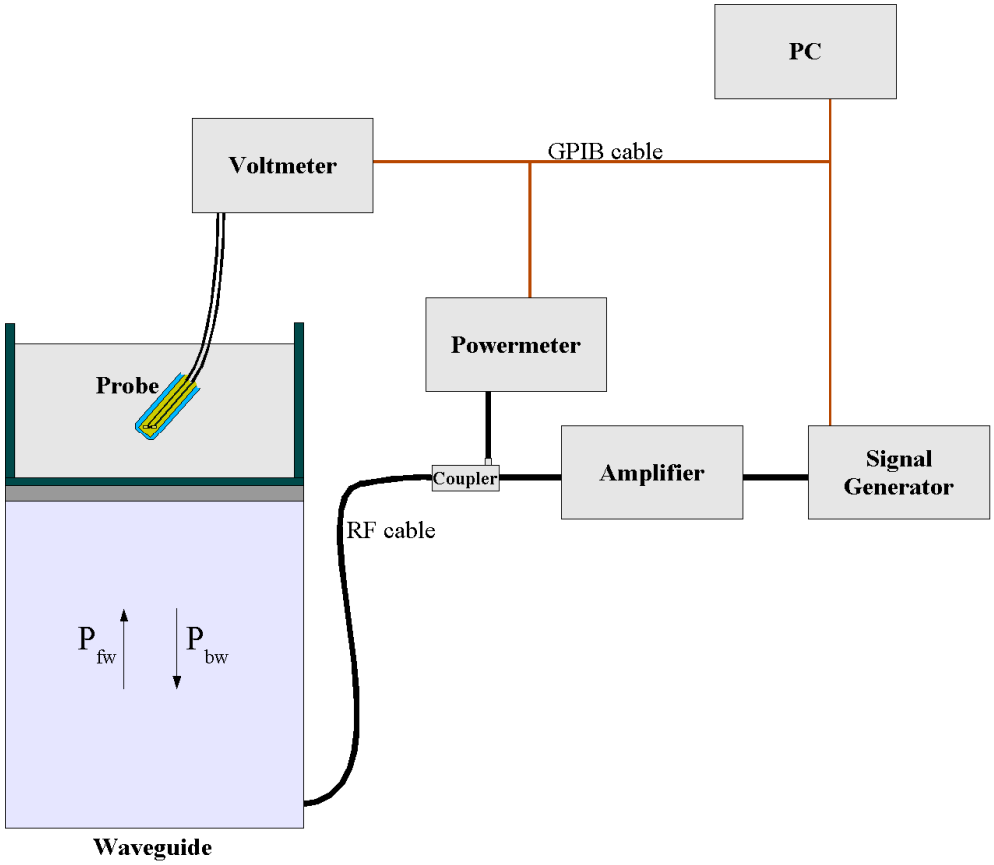
The probe could be checked by measuring the resistance of the three dipoles.

CALIBRATION TEST EQUIPMENT

TYPE	IDENTIFICATION
Calibration bench	CALISAR
Multimeter	Keithley 2000

MEASUREMENT PROCEDURE

Probe calibration is realized, in compliance with CENELEC EN 50361 and IEEE 1528 std, with CALISAR, Antennessa proprietary calibration system. The calibration is performed with the EN 50361 annexe technique using reference guide at the five frequencies.



$$SAR = \frac{4\left(P_{fw} - P_{bw}\right)}{ab\delta}\cos^2\left(\pi\frac{y}{a}\right)e^{-(2z/\delta)}$$

Where :

P_{fw} = Forward Power
P_{bw} = Backward Power
a and b = Waveguide dimensions
□ = Skin depth

Keithley configuration:

Rate = Medium; Filter =ON; RDGS=10; FILTER TYPE =MOVING AVERAGE; RANGE AUTO

After each calibration, a SAR measurement is performed on a validation dipole and compared with a NPL calibrated probe, to verify it.

PROBE UNCERTAINTIES

Calibration report of dosimetric SATIMO probe

Uncertainty on calibration system

ERROR SOURCES	Uncertainty value (%)	Probability Distribution	Divisor	ci	Standard Uncertainty (%)
Incident or forward power	3,00%	Rectangular	$\sqrt{3}$	1	1,732%
Reflected power	3,00%	Rectangular	$\sqrt{3}$	1	1,732%
Liquid conductivity	5,00%	Rectangular	$\sqrt{3}$	1	2,887%
Liquid permittivity	4,00%	Rectangular	$\sqrt{3}$	1	2,309%
Field homogeneity	3,00%	Rectangular	$\sqrt{3}$	1	1,732%
Field probe positioning	5,00%	Rectangular	$\sqrt{3}$	1	2,887%
Field probe linearity	3,00%	Rectangular	$\sqrt{3}$	1	1,732%
Combined standard uncertainty					4,761%
Expanded uncertainty (confidence interval of 95%)					9,331%

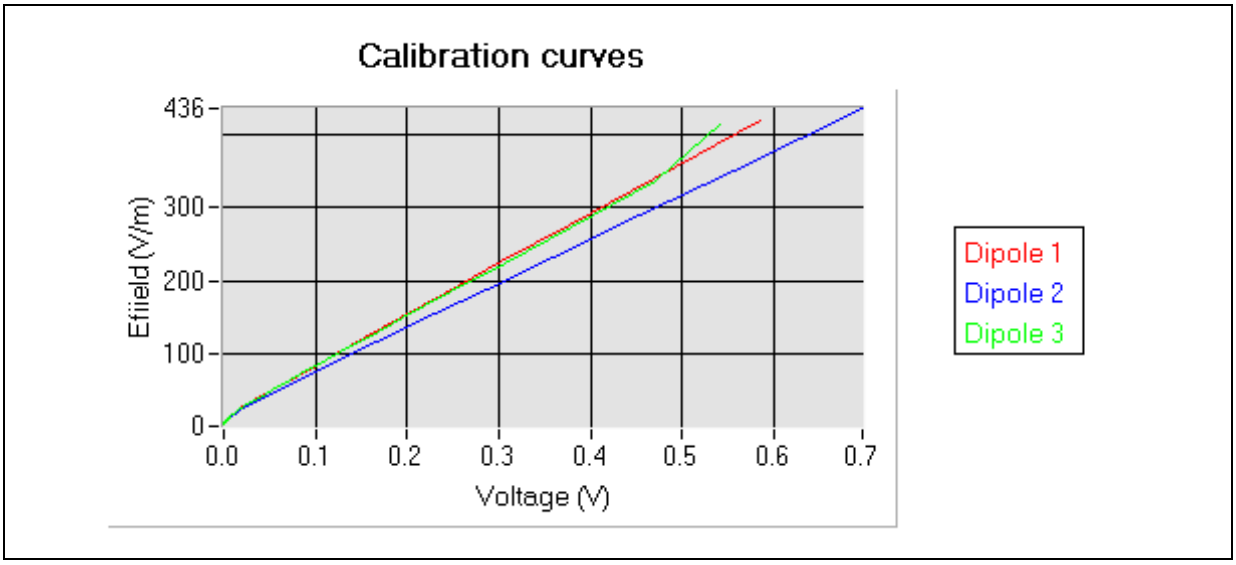
1. Calibration at 450.00 MHz

A. Calibration parameters.

Label	GSM450
Epsilon	43.33
Sigma	0.84 S/m
Temperature	21℃
Antenna gain	2.03 dB
Antenna S11	-10.50 dB
Low limit detection (CW)	0.72 V/m (0.47 mW/kg)

Calibration curves ei=f(V) (i=1,2,3) allow to obtain E-field value using the formula:

$$E = \sqrt{E_1^{\,2} * E_2^{\,2} * E_3^{\,2}}$$



The following tables represent the calibration curves linearization by curve segment in CW signal.

Calibration coefficients for the three dipoles in CW:

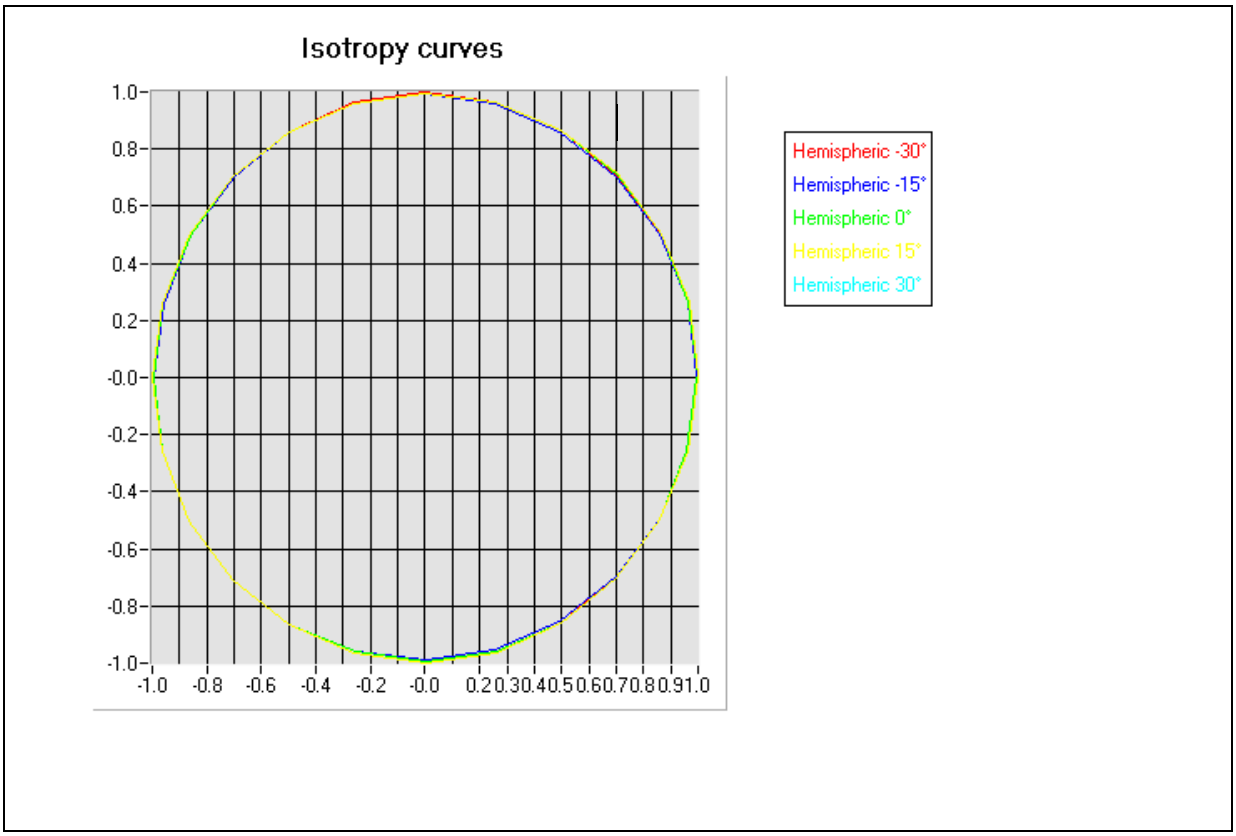
v1	e1	v2	e2	v3	e3
0.584004	419.557857	-0.696059	435.622023	0.541191	412.830715
0.467833	339.207465	-0.556278	351.381991	0.469757	336.297240
0.376994	276.348283	-0.452232	288.647980	0.378826	274.224190
0.302778	224.954643	-0.359005	232.397390	0.305842	224.365698
0.241038	182.154071	-0.286978	188.889931	0.246562	183.825274
0.192549	148.484090	-0.230386	154.650994	0.195712	148.993075
0.154033	121.674762	-0.185412	127.378480	0.157543	122.783107
0.123397	100.276479	-0.147311	104.193802	0.125866	100.956090
0.099878	83.770361	-0.118637	86.660489	0.101471	84.063863
0.081165	70.553219	-0.095250	72.263937	0.082289	70.694342
0.065166	59.152028	-0.076788	60.795323	0.066427	59.538957
0.051916	49.592416	-0.061280	51.041514	0.053353	50.232492
0.041968	42.297602	-0.048746	43.022565	0.042906	42.675214
0.033724	36.126757	-0.039149	36.748110	0.034686	36.605243
0.021855	26.962568	-0.024798	27.024723	0.022272	27.149463
0.018405	23.975145	-0.020856	24.085809	0.018755	24.141334
0.015467	21.515985	-0.017534	21.515985	0.015767	21.615299
0.013018	19.309065	-0.014750	19.398191	0.013276	19.487731
0.010938	17.408496	-0.012392	17.529166	0.011157	17.569575
0.009022	15.586953	-0.010228	15.658899	0.009215	15.676938
0.007353	13.956010	-0.008328	13.988181	0.007484	14.020428
0.005989	12.466979	-0.006801	12.495719	0.006111	12.567858
0.004890	11.214019	-0.005573	11.265779	0.005003	11.330818
0.004019	10.133541	-0.004570	10.121882	0.004099	10.168601
0.003279	9.094132	-0.003739	9.157170	0.003352	9.125596
0.002660	8.095827	-0.003041	8.293946	0.002769	8.265350
0.002126	7.324219	-0.002453	7.366500	0.002188	7.358024
0.001685	6.565400	-0.001947	6.580536	0.001724	6.542765
0.001300	5.784440	-0.001511	5.718225	0.001334	5.757862
0.001123	5.245191	-0.001307	5.269400	0.001174	5.275471
0.000891	4.701768	-0.001057	4.723470	0.000924	4.728912
0.000704	4.209798	-0.000850	4.226839	0.000736	4.243862
0.000574	3.790376	-0.000689	3.791428	0.000603	3.830551
0.000457	3.396200	-0.000570	3.434303	0.000483	3.421852
0.000365	3.050686	-0.000463	3.078014	0.000389	3.079630
0.000292	2.745766	-0.000369	2.726866	0.000311	2.759206
0.000236	2.486639	-0.000312	2.489933	0.000246	2.460514
0.000169	2.135693	-0.000243	2.168759	0.000192	2.181488
0.000128	1.889049	-0.000187	1.867932	0.000150	1.936874
0.000095	1.664186	-0.000151	1.645758	0.000107	1.649268
0.000060	1.386399	-0.000126	1.471869	0.000084	1.472551
0.000058	1.368824	-0.000108	1.332695	0.000065	1.308691
0.000037	1.168432	-0.000085	1.130188	0.000050	1.163135
0.000024	1.024929	-0.000073	1.008517	0.000039	1.043570
0.000020	0.976541	-0.000060	0.857441	0.000027	0.895101
0.000008	0.814304	-0.000053	0.763814	0.000017	0.749230
0.000004	0.752492	-0.000046	0.659669	0.000015	0.716502
-0.000002	0.651238	-0.000041	0.565593	0.000013	0.682204
-0.000007	0.553830	-0.000037	0.480995	0.000001	0.421392
-0.000010	0.477516	-0.000034	0.413108		
-0.000012	0.410144				

Sensitivity in liquid:

Liquid	ε	σ	CF dipole 1 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 2 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 3 ($W.kg^{-1}$ $(mV)^{-1}$)
Head	43.50	0.87	24.451	22.393	24.045
Body	58.00	0.83	24.691	22.414	24.201

B. Isotropy.

- Axial isotropy: 0.03 dB
- Hemispherical isotropy: 0.03 dB



C. Linearity.

- Linearity: 0.05 dB

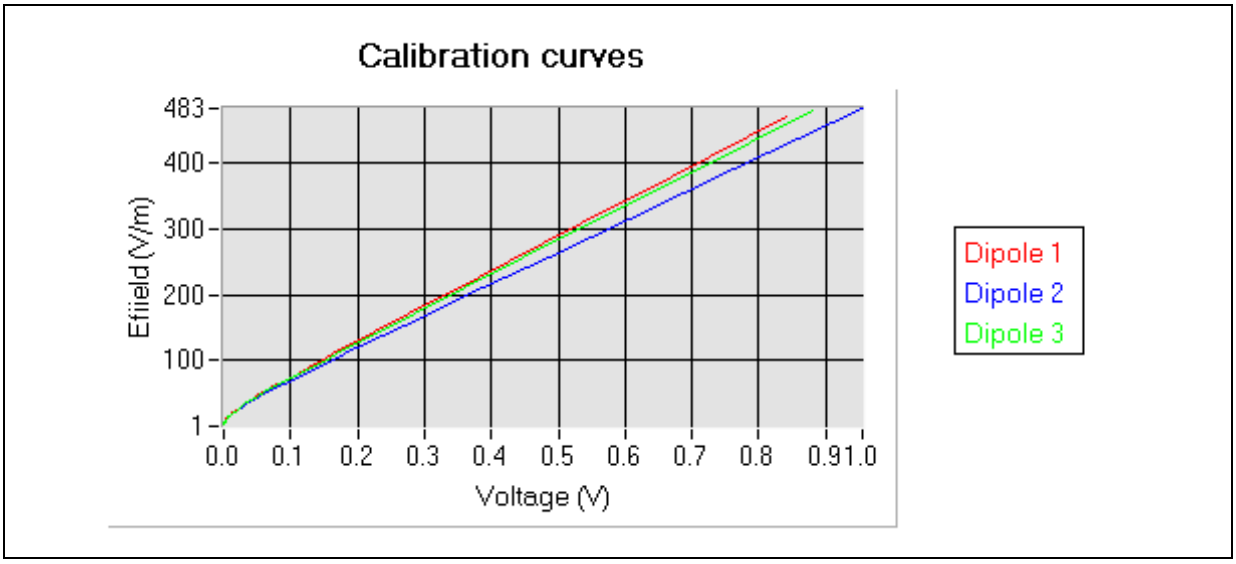
2. Calibration at 835.00 MHz

A. Calibration parameters.

Label	850
Epsilon	43.40
Sigma	0.89 S/m
Temperature	21℃
Cable loss	0.11 dB
Coupler loss	20.50 dB
Waveguide S11	-20.90 dB
Low limit detection	0.92 V/m (0.75 mW/kg)

Calibration curves ei=f(V) (i=1,2,3) allow to obtain E-field value using the formula:

$$E = \sqrt{E_1^{\,2} * E_2^{\,2} * E_3^{\,2}}$$



The following tables represent the calibration curves linearization by curve segment in CW signal.

Calibration coefficients for the three dipoles in CW:

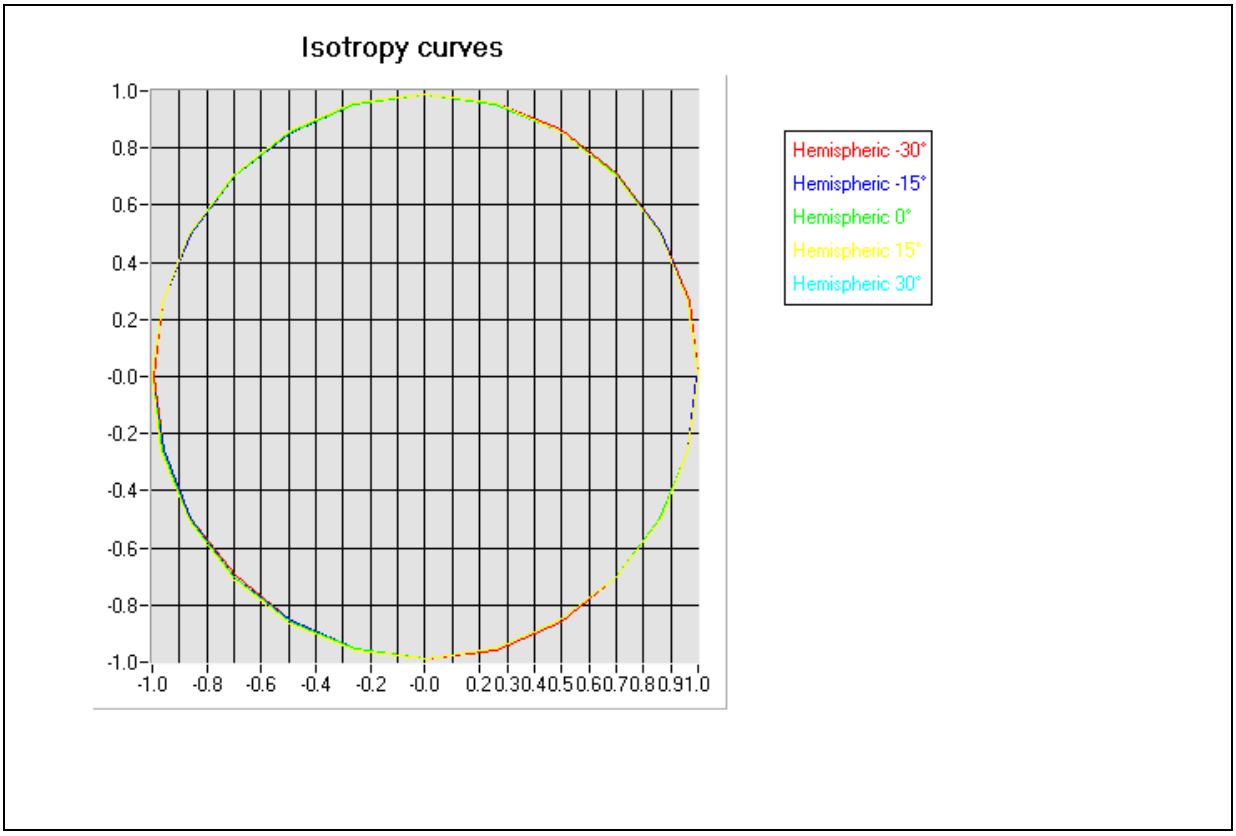
v1	e1	v2	e2	v3	e3
0.839252	469.730948	-0.954847	482.718447	0.879546	479.683033
0.668119	379.166614	-0.762014	390.347498	0.698229	385.999214
0.533716	307.961972	-0.606148	315.607901	0.558143	313.544664
0.426955	251.311080	-0.486812	258.298379	0.448077	256.531927
0.342037	206.144479	-0.387670	210.582203	0.360609	211.126634
0.276846	171.355772	-0.308360	172.284375	0.286505	172.535979
0.180629	118.178721	-0.197173	118.042741	0.185251	118.178721
0.163497	109.153907	-0.178754	109.153907	0.167665	109.153907
0.145275	99.549546	-0.159179	99.549546	0.149045	99.549546
0.127277	89.957894	-0.139807	89.957894	0.130662	89.854386
0.110307	80.730805	-0.121434	80.730805	0.113306	80.637914
0.094797	72.200346	-0.104643	72.200346	0.097445	72.117272
0.081814	64.944037	-0.090598	64.869310	0.084174	64.869310
0.069641	57.948111	-0.077338	57.881434	0.071699	57.881434
0.058878	51.586883	-0.065586	51.586883	0.060658	51.527524
0.049536	45.976857	-0.055336	45.976857	0.051073	45.923955
0.041505	40.976917	-0.046508	40.976917	0.042828	40.929767
0.034714	36.604905	-0.039026	36.562786	0.035889	36.562786
0.028810	32.586617	-0.032462	32.586617	0.029795	32.586617
0.023825	29.076310	-0.026929	29.076310	0.024666	29.076310
0.019557	25.914289	-0.022164	25.914289	0.020277	25.914289
0.015950	23.069558	-0.018115	23.043013	0.016542	23.043013
0.013090	20.655670	-0.014875	20.631903	0.013571	20.631903
0.010616	18.409385	-0.012100	18.388202	0.011028	18.388202
0.008582	16.407381	-0.009802	16.388503	0.008915	16.388503
0.006917	14.623094	-0.007914	14.623094	0.007191	14.606268
0.005549	13.017850	-0.006351	13.017850	0.005768	13.002872
0.004461	11.628917	-0.005124	11.628917	0.004648	11.615537
0.003564	10.352358	-0.004108	10.352358	0.003719	10.352358
0.002836	9.226549	-0.003286	9.226549	0.002977	9.226549
0.002259	8.223170	-0.002617	8.213708	0.002375	8.213708
0.001802	7.320476	-0.002093	7.320476	0.001895	7.320476
0.001429	6.532638	-0.001685	6.554495	0.001523	6.554495
0.001138	5.840422	-0.001336	5.834979	0.001210	5.834979
0.000899	5.203480	-0.001071	5.206420	0.000963	5.193805
0.000715	4.654101	-0.000853	4.640227	0.000762	4.623419
0.000576	4.191605	-0.000682	4.135607	0.000613	4.150307
0.000451	3.726997	-0.000549	3.707142	0.000502	3.759352
0.000357	3.335245	-0.000440	3.296394	0.000387	3.305900
0.000263	2.890885	-0.000359	2.958281	0.000306	2.944897
0.000207	2.590175	-0.000279	2.627855	0.000247	2.651180
0.000157	2.288534	-0.000229	2.368777	0.000190	2.332553
0.000132	2.121692	-0.000183	2.102414	0.000152	2.093365
0.000110	1.963178	-0.000153	1.908778	0.000119	1.860869
0.000075	1.680457	-0.000121	1.677779	0.000103	1.736978
0.000064	1.581195	-0.000093	1.445687	0.000078	1.523360
0.000029	1.212454	-0.000085	1.372183	0.000059	1.338399
0.000016	1.039547	-0.000076	1.284474	0.000047	1.207065
0.000006	0.888771	-0.000061	1.123173	0.000040	1.123386
-0.000001	0.763681	-0.000055	1.051749	0.000027	0.953273
-0.000006	0.660920	-0.000046	0.934431	0.000019	0.820744
-0.000010	0.562064	-0.000046	0.934431	0.000013	0.708836
		-0.000034	0.749985	0.000008	0.607750
		-0.000034	0.749985	0.000004	0.516845
		-0.000026	0.596115		
		-0.000022	0.509470		

Sensitivity in liquid:

Liquid	ε	σ	CF dipole 1 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 2 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 3 ($W.kg^{-1}$ $(mV)^{-1}$)
Head	41.50	0.90	28.479	25.214	27.196
Body	56.10	0.95	28.559	25.681	27.588

B. Isotropy.

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.04 dB



C. Linearity.

- Linearity: 0.07 dB

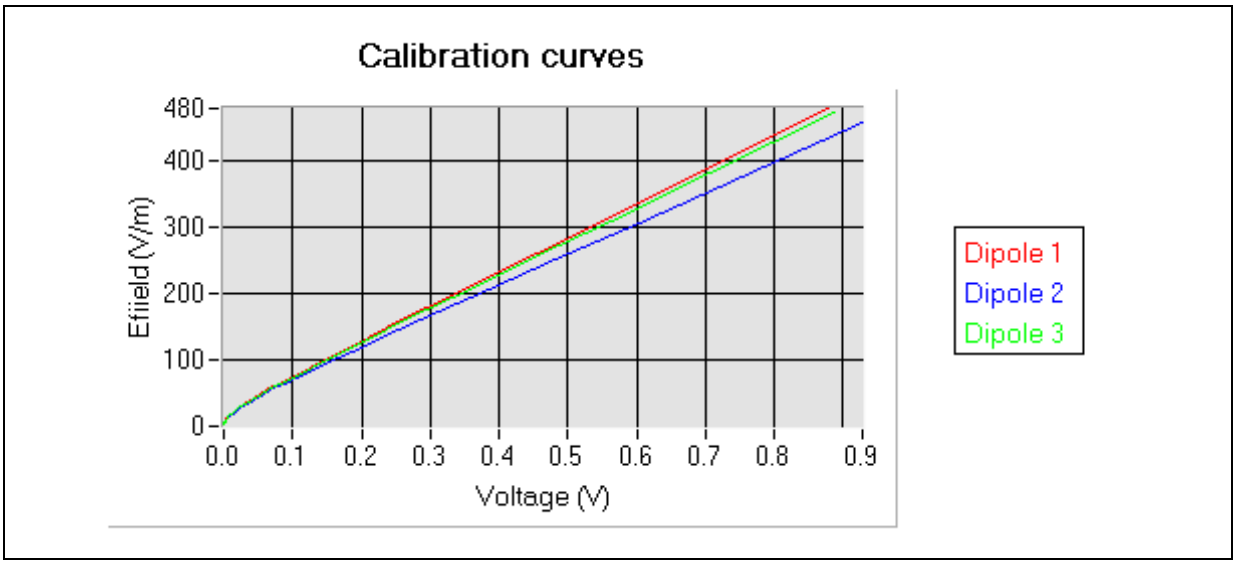
3. Calibration at 897.00 MHz

A. Calibration parameters.

Label	900
Epsilon	42.58
Sigma	0.96 S/m
Temperature	21℃
Cable loss	0.10 dB
Coupler loss	20.27 dB
Waveguide S11	-12.70 dB
Low limit detection	0.82 V/m (0.64 mW/kg)

Calibration curves ei=f(V) (i=1,2,3) allow to obtain E-field value using the formula:

$$E = \sqrt{E_1^{\,2} * E_2^{\,2} * E_3^{\,2}}$$



The following tables represent the calibration curves linearization by curve segment in CW signal.

Calibration coefficients for the three dipoles in CW:

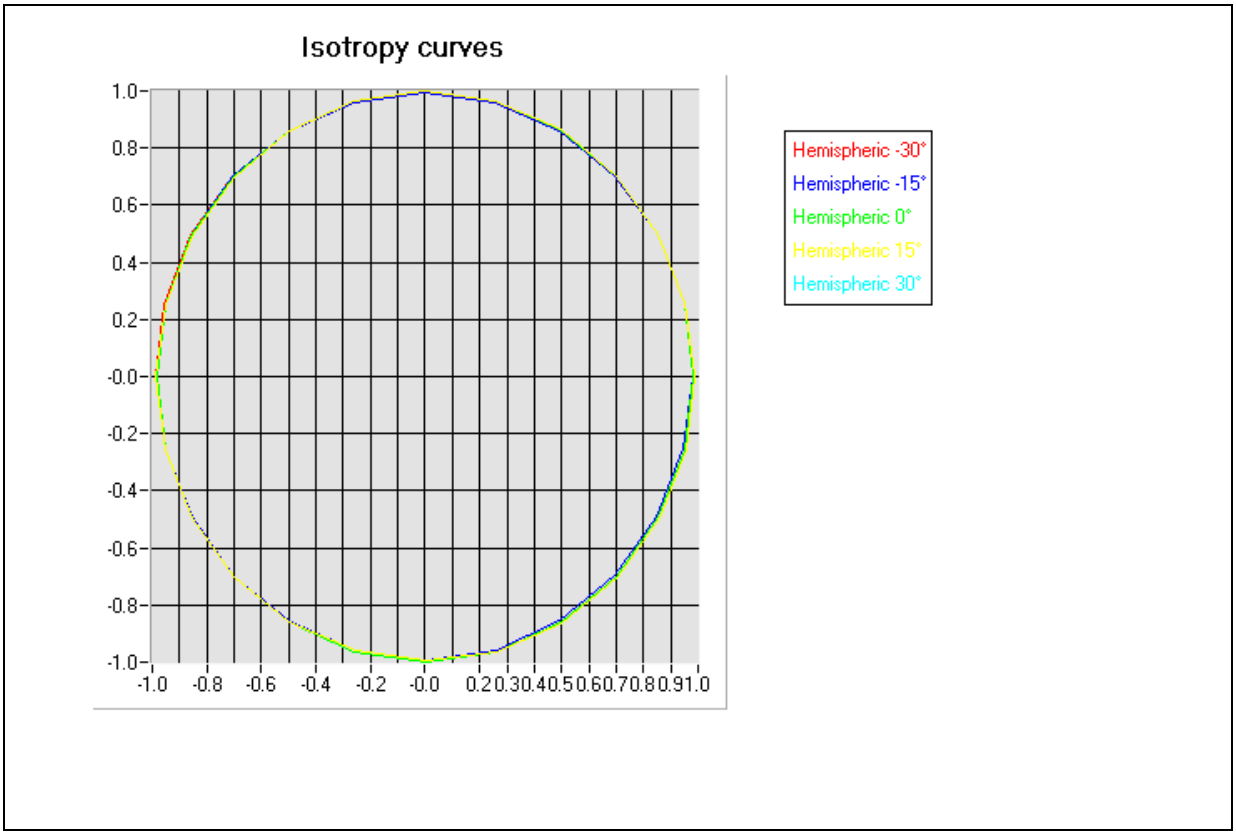
v1	e1	v2	e2	v3	e3
0.878810	479.977093	-0.928152	459.051477	0.886673	474.446145
0.699049	387.518511	-0.752319	377.321870	0.705070	382.994793
0.562801	317.354184	-0.603602	308.110116	0.562999	311.358915
0.456625	262.582111	-0.482616	251.698142	0.450632	254.594534
0.369216	217.381022	-0.386006	206.527074	0.363798	210.611269
0.293620	178.145102	-0.313396	172.446614	0.294302	175.279111
0.235810	147.981694	-0.254479	144.650728	0.237694	146.350348
0.188812	123.280907	-0.205809	121.524362	0.191549	122.597856
0.151354	103.395870	-0.166238	102.537341	0.155625	103.928232
0.098881	72.556308	-0.104845	72.556308	0.100895	72.807341
0.091615	69.290736	-0.098771	69.211008	0.093599	69.530471
0.082677	65.039197	-0.090592	65.039197	0.084502	65.189128
0.072569	59.934263	-0.079899	59.865301	0.074282	60.003305
0.061779	53.910725	-0.068273	53.910725	0.063236	54.035002
0.050267	47.008368	-0.056037	47.116734	0.051491	47.116734
0.042568	42.283913	-0.047620	42.332622	0.043641	42.381388
0.035946	38.078092	-0.040363	38.165871	0.036889	38.165871
0.030387	34.330108	-0.034169	34.409247	0.031134	34.448885
0.025582	30.986689	-0.028869	31.022384	0.026194	31.058120
0.021377	27.936705	-0.024181	27.968886	0.021863	27.968886
0.017722	25.128998	-0.020091	25.128998	0.018132	25.128998
0.014528	22.447872	-0.016484	22.447872	0.014809	22.422043
0.011676	19.914765	-0.013312	19.914765	0.011901	19.891849
0.009160	17.485384	-0.010469	17.485384	0.009337	17.465265
0.006717	14.797051	-0.007745	14.797051	0.006833	14.797051
0.005366	13.172711	-0.006210	13.187886	0.005458	13.172711
0.004307	11.780811	-0.005039	11.794382	0.004386	11.780811
0.003482	10.560274	-0.004078	10.572439	0.003548	10.572439
0.002814	9.498940	-0.003348	9.509883	0.002876	9.509883
0.002287	8.544274	-0.002732	8.554117	0.002314	8.549179
0.001835	7.676711	-0.002231	7.694408	0.001854	7.684445
0.001458	6.865548	-0.001811	6.874850	0.001467	6.873184
0.001140	6.093914	-0.001448	6.110581	0.001146	6.119211
0.000870	5.359101	-0.001147	5.395359	0.000872	5.392877
0.000602	4.512924	-0.000826	4.509302	0.000594	4.538660
0.000465	4.012011	-0.000681	4.045927	0.000459	4.059514
0.000363	3.594012	-0.000554	3.591290	0.000354	3.643540
0.000278	3.204293	-0.000471	3.260085	0.000265	3.249520
0.000230	2.961646	-0.000401	2.952011	0.000191	2.881168
0.000170	2.627007	-0.000341	2.659695	0.000142	2.608794
0.000140	2.442555	-0.000276	2.301496	0.000097	2.330782
0.000090	2.099426	-0.000248	2.128701	0.000061	2.081811
0.000056	1.829704	-0.000211	1.876111	0.000037	1.897771
0.000029	1.583109	-0.000185	1.675995	0.000008	1.648194
0.000022	1.512629	-0.000157	1.429490	-0.000017	1.402573
-0.000009	1.149689	-0.000136	1.212149	-0.000033	1.206539
-0.000007	1.176489	-0.000122	1.041385	-0.000047	1.024494
-0.000019	1.002716	-0.000112	0.900758	-0.000056	0.870486
-0.000028	0.852999	-0.000105	0.779999	-0.000063	0.751437
-0.000035	0.725064	-0.000098	0.665078	-0.000067	0.642982
-0.000039	0.616754	-0.000094	0.573192	-0.000071	0.555219
-0.000043	0.525443	-0.000091	0.488881	-0.000074	0.476607
-0.000045	0.447692				

Sensitivity in liquid:

Liquid	ε	σ	CF dipole 1 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 2 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 3 ($W.kg^{-1}$ $(mV)^{-1}$)
Head	41.50	0.97	32.062	27.383	31.065
Body	56.80	1.07	32.381	27.581	31.069

B. Isotropy.

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.04 dB



C. Linearity.

- Linearity: 0.08 dB

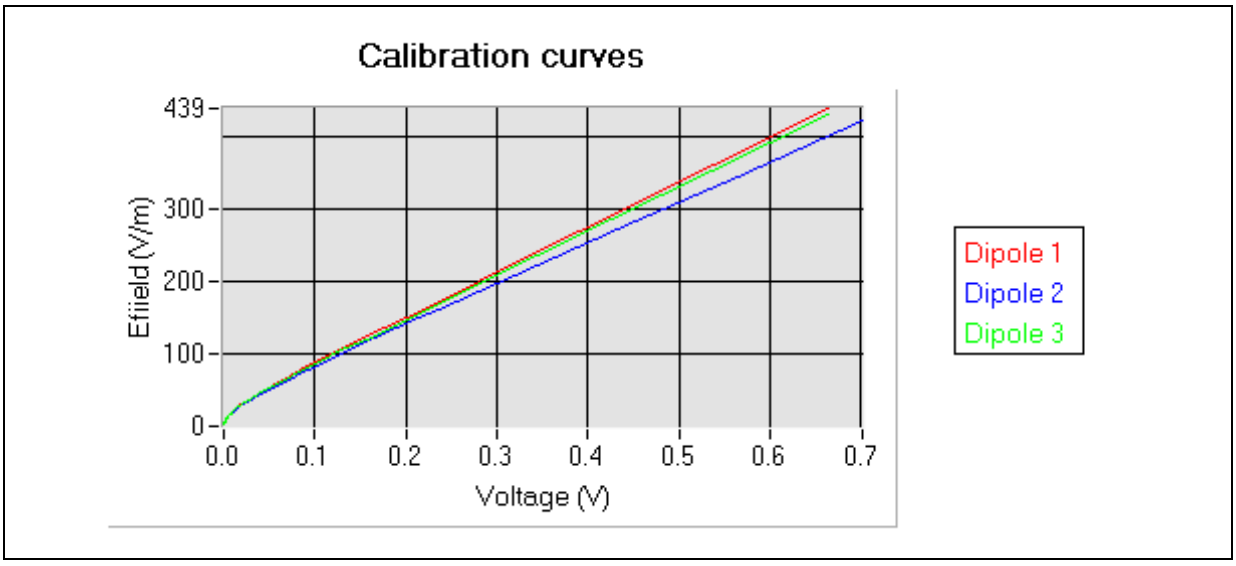
4. Calibration at 1747.00 MHz

A. Calibration parameters.

Label	1800
Epsilon	40.09
Sigma	1.38 S/m
Temperature	21℃
Cable loss	0.14 dB
Coupler loss	20.18 dB
Waveguide S11	-12.70 dB
Low limit detection	0.77 V/m (0.76 mW/kg)

Calibration curves ei=f(V) (i=1,2,3) allow to obtain E-field value using the formula:

$$E = \sqrt{E_1^{\,2} * E_2^{\,2} * E_3^{\,2}}$$



The following tables represent the calibration curves linearization by curve segment in CW signal.

Calibration coefficients for the three dipoles in CW:

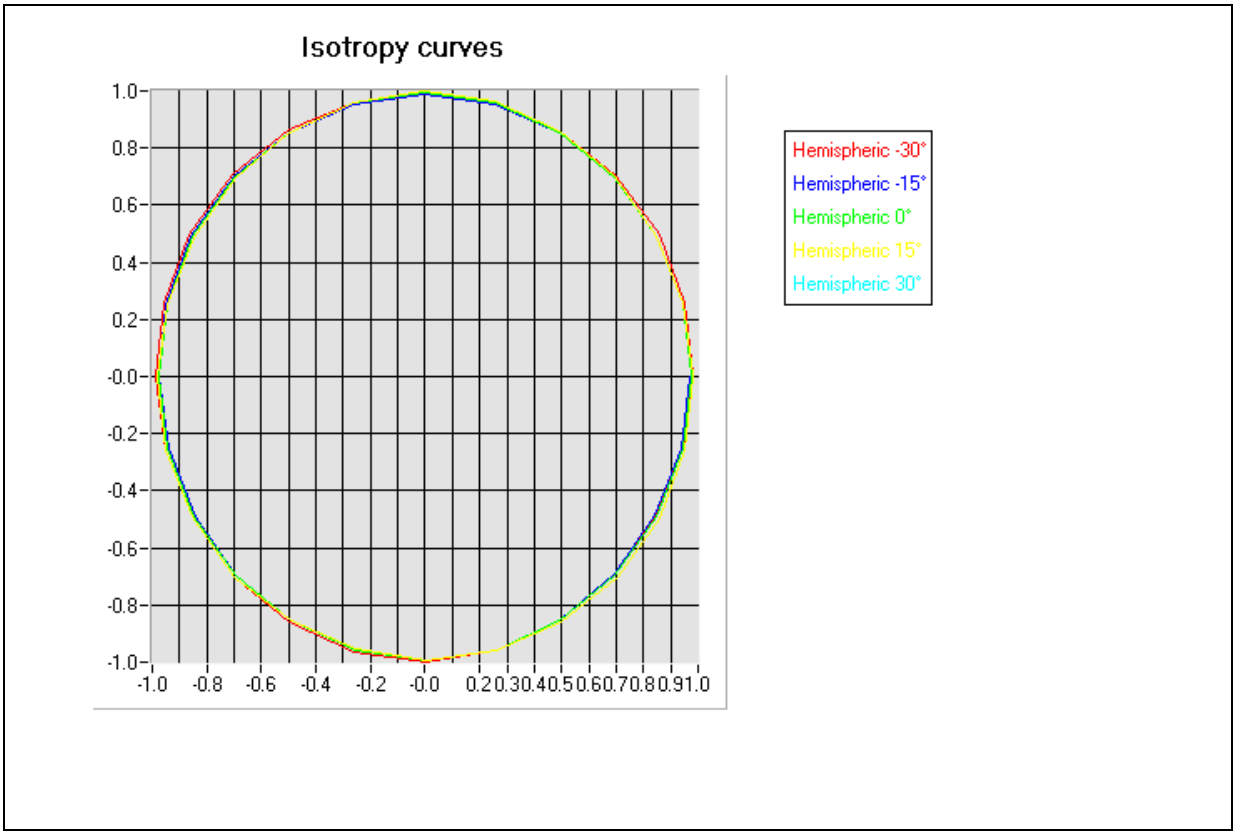
v1	e1	v2	e2	v3	e3
0.663731	438.804880	-0.701709	422.361031	0.663453	429.853445
0.539160	362.023035	-0.564539	345.724684	0.536788	353.373332
0.431901	295.807669	-0.451753	282.594309	0.426460	286.648108
0.343426	241.057307	-0.364982	233.896166	0.343134	236.130713
0.219808	160.277952	-0.235390	160.277952	0.223560	160.093531
0.199960	148.892830	-0.214656	149.064347	0.203583	148.379460
0.176749	135.012440	-0.190364	135.323676	0.179925	134.701919
0.153903	121.303627	-0.166397	121.583260	0.156830	121.024636
0.132690	108.236511	-0.144052	108.486023	0.135416	108.111971
0.114103	96.688269	-0.124392	96.911158	0.116620	96.577017
0.098196	86.471658	-0.107364	86.670996	0.100436	86.372161
0.084369	77.512863	-0.092566	77.691549	0.086455	77.423676
0.072516	69.642408	-0.079735	69.802951	0.074359	69.562276
0.062289	62.715341	-0.068695	62.787586	0.063969	62.715341
0.053507	56.542341	-0.059144	56.737969	0.055031	56.607475
0.045565	50.859699	-0.050463	50.976943	0.046806	50.801177
0.036953	44.501412	-0.041052	44.603998	0.038010	44.501412
0.030069	39.162805	-0.033529	39.253084	0.030974	39.162805
0.024559	34.623724	-0.027457	34.703541	0.025331	34.663610
0.020114	30.822921	-0.022570	30.893975	0.020790	30.822921
0.016497	27.502602	-0.018554	27.566001	0.017063	27.534284
0.013562	24.624860	-0.015276	24.681628	0.014044	24.653228
0.011154	22.124516	-0.012611	22.175519	0.011567	22.150003
0.009196	19.923873	-0.010407	19.969804	0.009549	19.969804
0.007595	17.983483	-0.008614	18.024938	0.007887	18.024938
0.006237	16.194732	-0.007082	16.232065	0.006466	16.213389
0.004819	14.153825	-0.005485	14.186452	0.004999	14.186452
0.003758	12.470210	-0.004301	12.484575	0.003902	12.470210
0.002958	11.024878	-0.003393	11.050293	0.003070	11.037578
0.002353	9.803334	-0.002699	9.825932	0.002439	9.814627
0.001870	8.747294	-0.002168	8.757373	0.001956	8.767460
0.001499	7.841042	-0.001746	7.850074	0.001564	7.859117
0.001206	7.036777	-0.001411	7.052998	0.001257	7.061124
0.000974	6.336855	-0.001152	6.358779	0.001020	6.366104
0.000795	5.726296	-0.000949	5.739497	0.000830	5.739497
0.000619	5.052889	-0.000742	5.050958	0.000640	5.050958
0.000461	4.393269	-0.000572	4.414421	0.000483	4.424549
0.000356	3.893589	-0.000447	3.916767	0.000370	3.896823
0.000272	3.442008	-0.000345	3.420826	0.000287	3.458278
0.000212	3.079166	-0.000284	3.086385	0.000223	3.077746
0.000171	2.804352	-0.000237	2.801601	0.000174	2.751051
0.000125	2.459743	-0.000185	2.448220	0.000141	2.507157
0.000097	2.223990	-0.000164	2.290103	0.000108	2.236826
0.000078	2.048621	-0.000135	2.051816	0.000085	2.027207
0.000057	1.835400	-0.000102	1.741442	0.000065	1.825466
0.000043	1.678270	-0.000098	1.699975	0.000053	1.692922
0.000027	1.478382	-0.000082	1.522855	0.000041	1.549077
0.000017	1.338378	-0.000066	1.322219	0.000023	1.303888
0.000005	1.148052	-0.000054	1.148974	0.000015	1.178656
0.000002	1.095316	-0.000049	1.068531	0.000011	1.110757
-0.000006	0.937825	-0.000043	0.963171	0.000002	0.940225
-0.000012	0.811741	-0.000036	0.823385	-0.000004	0.809110
-0.000016	0.698282	-0.000031	0.712959	-0.000008	0.697060
-0.000019	0.597362	-0.000027	0.605013	-0.000012	0.596303
-0.000022	0.508555	-0.000025	0.523033	-0.000014	0.515459
-0.000024	0.437175	-0.000023	0.450836	-0.000016	0.443307

Sensitivity in liquid:

Liquid	ε	σ	CF dipole 1 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 2 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 3 ($W.kg^{-1}$ $(mV)^{-1}$)
Head	42.00	1.40	42.533	36.791	41.019
Body	54.00	1.45	42.982	37.514	41.835

B. Isotropy.

- Axial isotropy: 0.05 dB
- Hemispherical isotropy: 0.06 dB



C. Linearity.

- Linearity: 0.08 dB

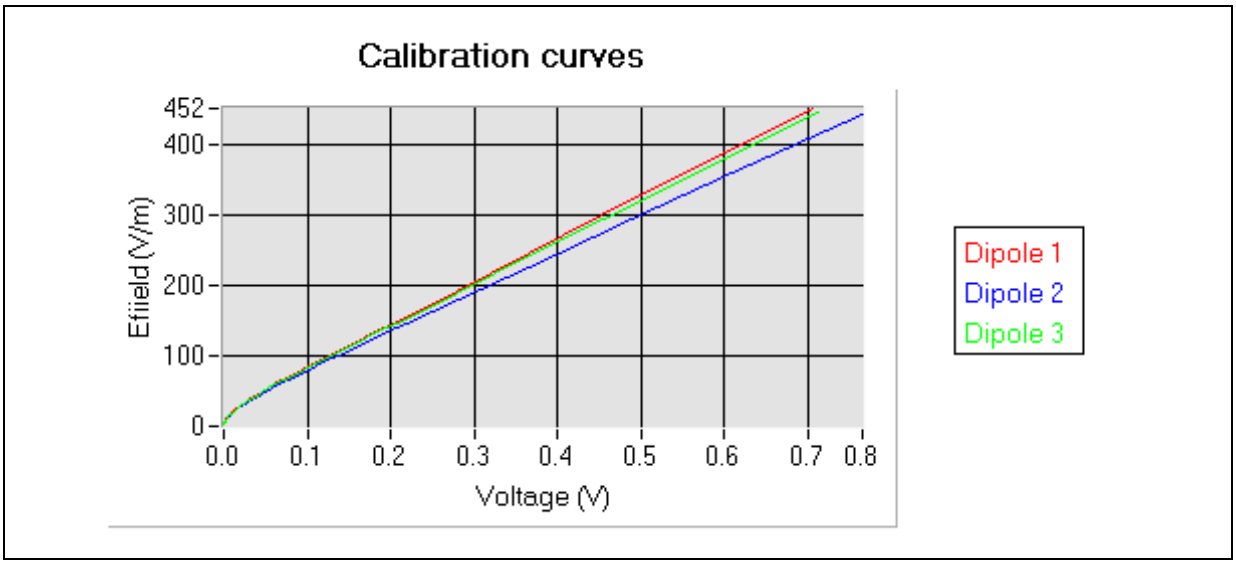
5. Calibration at 1880.00 MHz

A. Calibration parameters.

Label	1900
Epsilon	39.68
Sigma	1.39 S/m
Temperature	21℃
Cable loss	0.15 dB
Coupler loss	20.12 dB
Waveguide S11	-32.10 dB
Low limit detection	0.82 V/m (0.93 mW/kg)

Calibration curves ei=f(V) (i=1,2,3) allow to obtain E-field value using the formula:

$$E = \sqrt{E_1^{\,2} * E_2^{\,2} * E_3^{\,2}}$$



The following tables represent the calibration curves linearization by curve segment in CW signal.

Calibration coefficients for the three dipoles in CW:

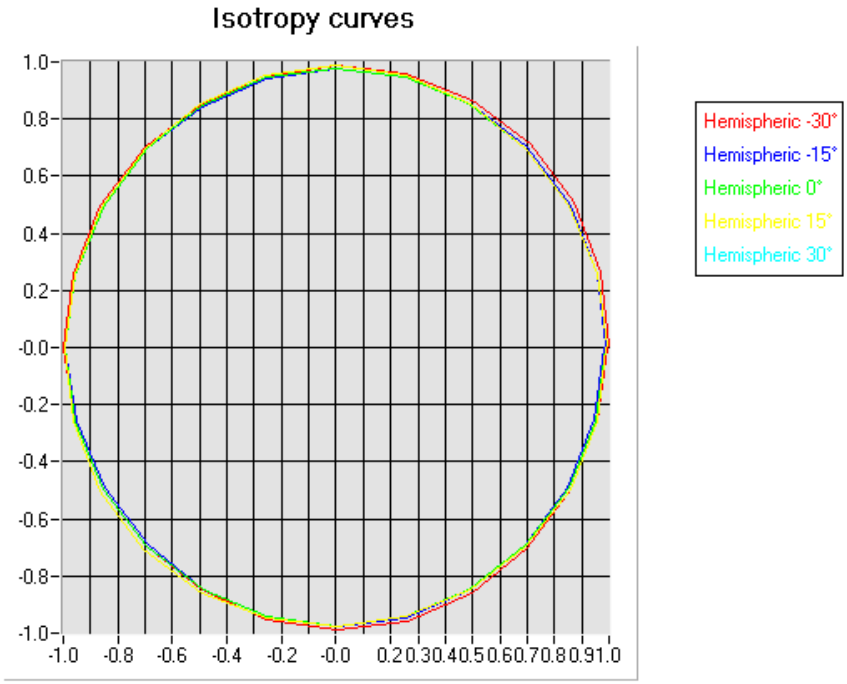
v1	e1	v2	e2	v3	e3
0.705687	452.433469	-0.764862	444.880127	0.711360	446.684059
0.563683	367.171675	-0.608616	360.024001	0.572685	365.129747
0.452345	300.224376	-0.487470	294.121999	0.454781	295.690095
0.364839	247.497983	-0.395865	244.176010	0.366095	243.346556
0.233395	163.656692	-0.249573	163.656692	0.237445	163.656692
0.215075	153.261745	-0.230502	153.438296	0.219204	153.261745
0.191763	139.937390	-0.206083	140.098591	0.195785	140.098591
0.167877	125.873344	-0.180901	126.163511	0.171664	126.308846
0.145753	112.832385	-0.157556	113.092489	0.149292	113.222768
0.126236	101.142520	-0.136873	101.259030	0.129435	101.492457
0.108989	90.559448	-0.118604	90.663768	0.111932	90.872769
0.094057	81.177144	-0.102669	81.364277	0.096737	81.551841
0.080982	72.934627	-0.088705	73.102759	0.083414	73.271278
0.069714	65.604521	-0.076562	65.755754	0.071914	65.907337
0.059985	59.215277	-0.066067	59.351782	0.061926	59.488602
0.051909	53.756844	-0.057334	53.880767	0.053598	53.942835
0.042215	46.982246	-0.046814	47.036367	0.043656	47.144797
0.034444	41.298451	-0.038327	41.393653	0.035678	41.441338
0.028208	36.511843	-0.031481	36.596012	0.029255	36.638170
0.023204	32.466372	-0.025945	32.541214	0.024075	32.616231
0.019074	28.969017	-0.021384	29.035797	0.019810	29.102733
0.015712	25.937838	-0.017664	25.997630	0.016340	26.057561
0.012954	23.304177	-0.014597	23.357899	0.013487	23.384805
0.010696	20.962051	-0.012072	21.010373	0.011146	21.058807
0.008846	18.920550	-0.010001	18.964167	0.009222	19.007884
0.007320	17.117241	-0.008280	17.136959	0.007622	17.156700
0.005669	14.942861	-0.006432	14.977308	0.005902	14.994562
0.004418	13.135112	-0.005030	13.165392	0.004607	13.180557
0.003480	11.612714	-0.003970	11.639485	0.003632	11.666316
0.002760	10.337935	-0.003165	10.349843	0.002885	10.361766
0.002209	9.213693	-0.002527	9.234933	0.002300	9.256223
0.001769	8.249616	-0.002042	8.268634	0.001851	8.278160
0.001425	7.411972	-0.001657	7.420510	0.001492	7.437617
0.001154	6.667051	-0.001350	6.682420	0.001208	6.697825
0.000934	6.017745	-0.001105	6.031617	0.000980	6.035436
0.000716	5.271494	-0.000849	5.265501	0.000745	5.279016
0.000539	4.606218	-0.000654	4.609655	0.000566	4.620497
0.000413	4.059511	-0.000512	4.066035	0.000437	4.080555
0.000317	3.587480	-0.000405	3.602614	0.000335	3.596690
0.000249	3.211417	-0.000324	3.207578	0.000271	3.256587
0.000199	2.903996	-0.000268	2.903208	0.000212	2.908029
0.000152	2.581857	-0.000216	2.588731	0.000157	2.540391
0.000121	2.345289	-0.000176	2.317973	0.000133	2.362102
0.000090	2.082012	-0.000151	2.131354	0.000100	2.092295
0.000072	1.912583	-0.000126	1.926743	0.000083	1.938704
0.000055	1.737461	-0.000107	1.755360	0.000061	1.719695
0.000036	1.518014	-0.000084	1.522296	0.000046	1.552761
0.000025	1.375051	-0.000073	1.397154	0.000030	1.352169
0.000010	1.151852	-0.000060	1.232991	0.000019	1.194885
0.000009	1.135413	-0.000046	1.027269	0.000009	1.028022
0.000003	1.031291	-0.000037	0.872937	0.000001	0.874876
-0.000005	0.880469	-0.000031	0.752345	-0.000005	0.749785
-0.000010	0.760355	-0.000027	0.645069	-0.000009	0.639312
-0.000014	0.651604	-0.000023	0.551655	-0.000012	0.551888
-0.000017	0.554581	-0.000021	0.468256	-0.000014	0.473314
-0.000019	0.478585				

Sensitivity in liquid:

Liquid	ε	σ	CF dipole 1 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 2 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 3 ($W.kg^{-1}$ $(mV)^{-1}$)
Head	42.00	1.40	40.136	34.843	38.721
Body	54.00	1.45	40.625	34.773	38.535

B. Isotropy.

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.07 dB



C. Linearity.

- Linearity: 0.12 dB

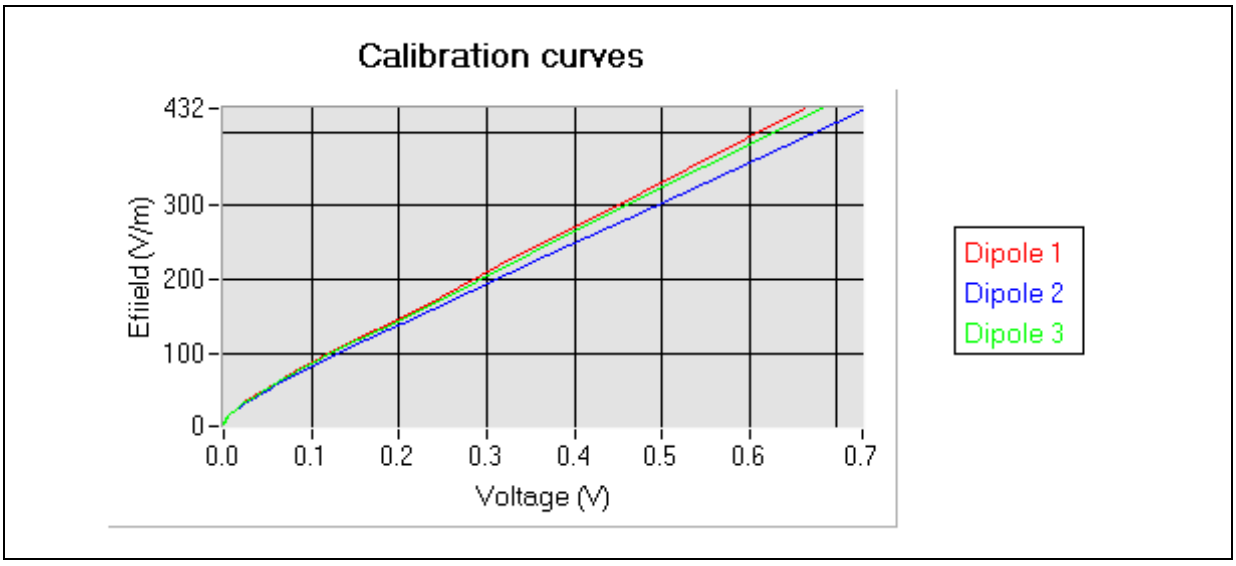
6. Calibration at 1950.00 MHz

A. Calibration parameters.

Label	2000
Epsilon	39.69
Sigma	1.44 S/m
Temperature	21℃
Cable loss	0.14 dB
Coupler loss	20.12 dB
Waveguide S11	-31.20 dB
Low limit detection	0.79 V/m (0.89 mW/kg)

Calibration curves ei=f(V) (i=1,2,3) allow to obtain E-field value using the formula:

$$E = \sqrt{E_1^{\,2} * E_2^{\,2} * E_3^{\,2}}$$



The following tables represent the calibration curves linearization by curve segment in CW signal.

Calibration coefficients for the three dipoles in CW:

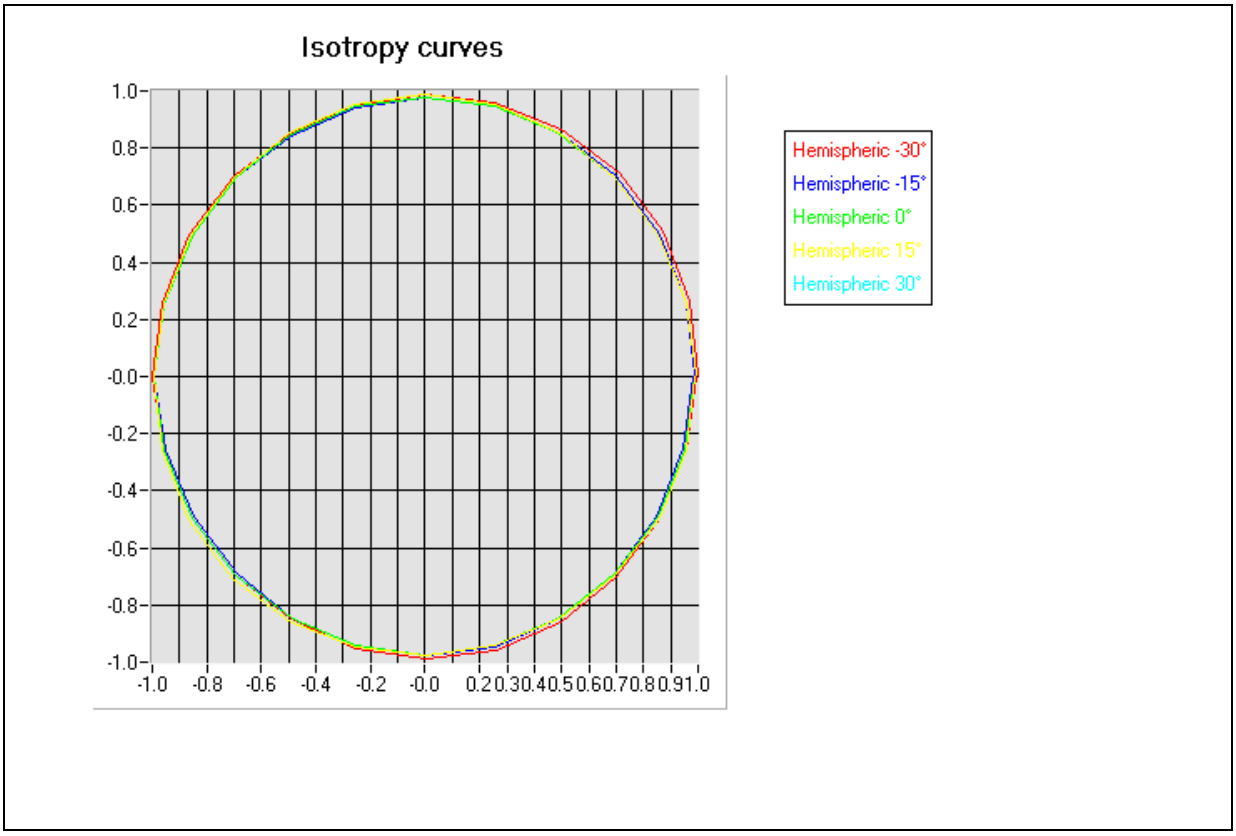
v1	e1	v2	e2	v3	e3
0.661947	431.378356	-0.728866	429.451431	0.681969	432.242640
0.528785	350.395683	-0.580429	348.089093	0.548843	353.466289
0.423011	285.964354	-0.461683	282.880864	0.436057	286.620025
0.338877	234.593477	-0.370019	232.409000	0.351179	236.196574
0.222899	159.936072	-0.239382	159.752045	0.227301	159.936072
0.199714	146.536706	-0.214934	146.368096	0.203996	146.536706
0.173676	131.052837	-0.187341	131.203804	0.177783	131.354944
0.149407	116.666568	-0.161622	116.666568	0.153166	116.935513
0.127916	103.501448	-0.138841	103.620677	0.131334	103.740044
0.109450	92.033603	-0.119179	92.245763	0.112533	92.352025
0.093698	82.025035	-0.102267	82.214122	0.096429	82.308830
0.080261	73.442327	-0.087875	73.526929	0.082737	73.611628
0.068722	65.833421	-0.075460	65.909259	0.070899	65.985183
0.058889	59.148866	-0.064861	59.285219	0.060789	59.353513
0.050483	53.326911	-0.055737	53.449842	0.052146	53.573057
0.043169	48.188835	-0.047771	48.244346	0.044590	48.244346
0.034915	42.067473	-0.038773	42.164449	0.036094	42.164449
0.028320	36.978256	-0.031538	37.020853	0.029302	37.063499
0.023047	32.692372	-0.025741	32.730031	0.023873	32.767735
0.018835	29.070093	-0.021098	29.103581	0.019526	29.137107
0.015403	25.908747	-0.017291	25.968474	0.015986	25.998389
0.012633	23.197780	-0.014207	23.251256	0.013114	23.278041
0.010363	20.842337	-0.011685	20.866346	0.010777	20.890384
0.008536	18.747633	-0.009633	18.790850	0.008871	18.812496
0.007026	16.921794	-0.007949	16.941288	0.007315	16.960804
0.005944	15.486255	-0.006726	15.504096	0.006179	15.521955
0.004583	13.534632	-0.005194	13.550222	0.004768	13.565833
0.003563	11.883556	-0.004053	11.897245	0.003715	11.910951
0.002797	10.506219	-0.003195	10.518321	0.002915	10.530438
0.002218	9.331392	-0.002543	9.352903	0.002312	9.363676
0.001764	8.326192	-0.002030	8.335784	0.001837	8.355000
0.001416	7.454979	-0.001638	7.472164	0.001472	7.472164
0.001131	6.690313	-0.001320	6.698020	0.001198	6.705736
0.000915	6.017920	-0.001077	6.031794	0.000960	6.038741
0.000741	5.425583	-0.000885	5.444355	0.000783	5.450626
0.000565	4.763722	-0.000684	4.769210	0.000588	4.754705
0.000426	4.161853	-0.000527	4.177788	0.000448	4.170438
0.000324	3.660725	-0.000407	3.668144	0.000344	3.676792
0.000254	3.272711	-0.000330	3.276639	0.000278	3.325727
0.000190	2.872448	-0.000263	2.907182	0.000218	2.970792
0.000158	2.649739	-0.000216	2.617066	0.000165	2.617533
0.000126	2.406508	-0.000180	2.370960	0.000125	2.315507
0.000089	2.090282	-0.000141	2.071612	0.000103	2.131227
0.000070	1.907632	-0.000125	1.935455	0.000073	1.850594
0.000052	1.716763	-0.000105	1.750428	0.000063	1.747061
0.000040	1.576733	-0.000087	1.565314	0.000050	1.602499
0.000019	1.295764	-0.000068	1.342505	0.000027	1.308170
0.000012	1.187425	-0.000062	1.264011	0.000024	1.264739
0.000006	1.085994	-0.000052	1.121039	0.000017	1.157079
0.000002	1.012745	-0.000044	0.991934	0.000004	0.924453
0.000000	0.974057	-0.000044	0.991934	-0.000002	0.792898
-0.000006	0.841386	-0.000033	0.780282	-0.000006	0.682531
-0.000011	0.721397	-0.000031	0.735283	-0.000010	0.590964
-0.000015	0.616765	-0.000027	0.630434	-0.000012	0.501475
-0.000017	0.529958	-0.000024	0.544930	-0.000014	0.431758
-0.000019	0.458647	-0.000022	0.469734		

Sensitivity in liquid:

Liquid	ε	σ	CF dipole 1 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 2 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 3 ($W.kg^{-1}$ $(mV)^{-1}$)
Head	42.00	1.40	40.977	35.416	39.388
Body	54.00	1.45	41.326	36.005	40.117

B. Isotropy.

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.07 dB



C. Linearity.

- Linearity: 0.13 dB

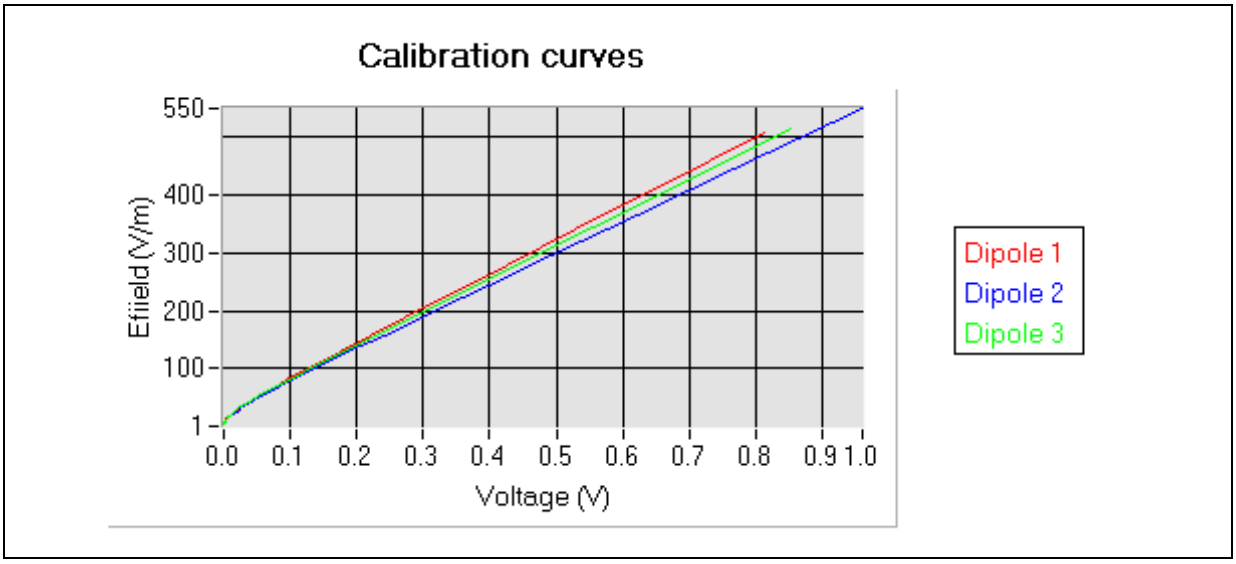
7. Calibration at 2450.00 MHz

A. Calibration parameters.

Label	2450
Epsilon	37.93
Sigma	1.89 S/m
Temperature	21℃
Cable loss	0.13 dB
Coupler loss	21.51 dB
Waveguide S11	-13.20 dB
Low limit detection	0.92 V/m (1.58 mW/kg)

Calibration curves ei=f(V) (i=1,2,3) allow to obtain E-field value using the formula:

$$E = \sqrt{E_1^{\,2} * E_2^{\,2} * E_3^{\,2}}$$



The following tables represent the calibration curves linearization by curve segment in CW signal.

Calibration coefficients for the three dipoles in CW:

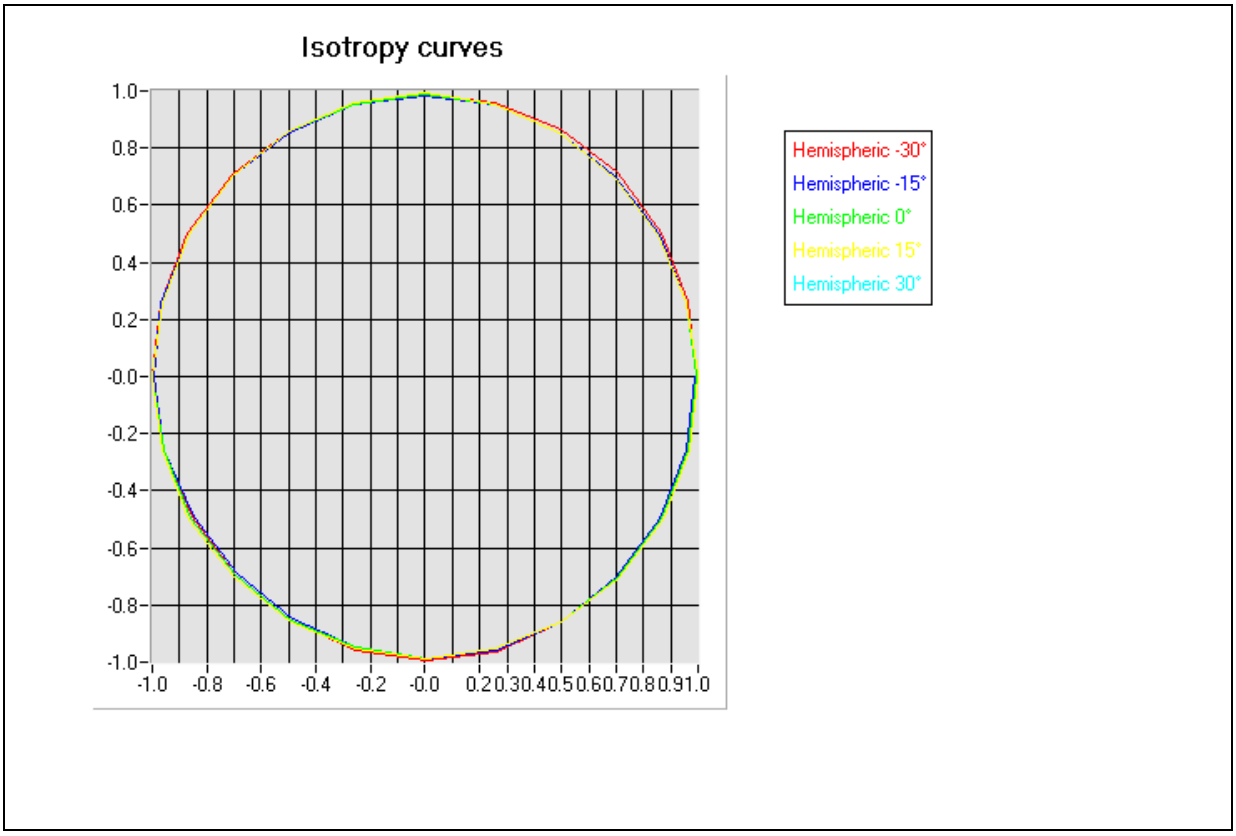
v1	e1	v2	e2	v3	e3
0.811011	506.364572	-0.960250	549.576775	0.852378	513.168901
0.654685	414.338278	-0.765658	443.865967	0.690132	421.007684
0.527958	339.653217	-0.620567	364.975082	0.555542	344.472882
0.426242	279.610707	-0.492754	295.384135	0.448357	283.424871
0.343625	230.727305	-0.399627	244.577703	0.360025	232.997679
0.272758	188.648406	-0.320299	201.177838	0.289397	192.540954
0.219562	156.902806	-0.255170	165.396787	0.231016	158.937231
0.175415	130.373321	-0.205220	137.792360	0.187773	133.881325
0.141416	109.746862	-0.163038	114.288007	0.151432	112.638859
0.114684	93.328263	-0.131858	96.719904	0.122274	95.390988
0.092577	79.531494	-0.106512	82.235294	0.098545	81.132443
0.074356	67.920300	-0.084551	69.442209	0.078767	69.000273
0.059797	58.393153	-0.068505	59.864104	0.063888	59.636096
0.048340	50.651528	-0.054651	51.344452	0.051593	51.656619
0.038647	43.841849	-0.043800	44.418369	0.041113	44.588164
0.031040	38.242197	-0.035080	38.602454	0.033393	39.142320
0.024879	33.458730	-0.028075	33.684563	0.026560	34.065375
0.020174	29.583828	-0.022652	29.652906	0.021545	30.111874
0.012901	22.966984	-0.014603	23.072995	0.013652	23.232931
0.011713	21.782313	-0.013215	21.807405	0.012179	21.832526
0.009144	19.037240	-0.010337	19.081125	0.009516	19.081125
0.007180	16.734163	-0.008138	16.753440	0.007467	16.772738
0.005669	14.777602	-0.006448	14.811669	0.005904	14.811669
0.004512	13.125141	-0.005148	13.155398	0.004710	13.155398
0.003623	11.711270	-0.004135	11.724760	0.003775	11.738267
0.002917	10.473792	-0.003340	10.497939	0.003038	10.510032
0.002366	9.410312	-0.002706	9.421152	0.002464	9.421152
0.001911	8.464552	-0.002207	8.484065	0.001997	8.484065
0.001554	7.640188	-0.001806	7.648988	0.001630	7.657799
0.001292	6.949638	-0.001507	6.975959	0.001346	6.975959
0.000981	6.073873	-0.001152	6.089814	0.001035	6.096828
0.000753	5.341375	-0.000898	5.359250	0.000788	5.353082
0.000591	4.752804	-0.000705	4.727200	0.000617	4.732646
0.000455	4.195415	-0.000560	4.209852	0.000485	4.193764
0.000359	3.752442	-0.000450	3.761341	0.000376	3.750627
0.000282	3.355136	-0.000357	3.335421	0.000296	3.358180
0.000222	3.009404	-0.000295	3.018267	0.000240	3.042913
0.000184	2.768196	-0.000241	2.711983	0.000186	2.707184
0.000144	2.489167	-0.000206	2.493450	0.000153	2.479740
0.000113	2.249238	-0.000171	2.253828	0.000121	2.237214
0.000080	1.961844	-0.000142	2.034010	0.000097	2.036452
0.000052	1.679871	-0.000108	1.741305	0.000063	1.712208
0.000040	1.543335	-0.000088	1.543409	0.000045	1.512668
0.000026	1.366913	-0.000075	1.399853	0.000036	1.402290
0.000012	1.169294	-0.000066	1.291153	0.000023	1.225427
0.000003	1.010080	-0.000056	1.158473	0.000017	1.134538
-0.000005	0.857979	-0.000046	1.008485	0.000011	1.035703
-0.000010	0.733105	-0.000045	0.992241	0.000008	0.982563
-0.000014	0.623382	-0.000037	0.854719	0.000005	0.926381
-0.000017	0.530190	-0.000031	0.734132	0.000005	0.926381
		-0.000027	0.633745	-0.000001	0.802299
		-0.000024	0.541792	-0.000006	0.686256
				-0.000009	0.593698
				-0.000012	0.512925

Sensitivity in liquid:

Liquid	ε	σ	CF dipole 1 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 2 ($W.kg^{-1}$ $(mV)^{-1}$)	CF dipole 3 ($W.kg^{-1}$ $(mV)^{-1}$)
Head	39.20	1.80	39.563	33.614	37.677
Body	52.50	1.78	39.772	33.946	37.835

B. Isotropy.

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.06 dB



C. Linearity.

- Linearity: 0.13 dB