

## COMOSAR E-Field probe Calibration Report



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Issue: A

Date: 2012/10/04

## COMOSAR E-FIELD PROBE CALIBRATION REPORT

Prepared By: LUC Jérôme, SATIMO

Project Description: SAR TEST BENCH

Prepared For (End User): Shenzhen Morlab Communication Technology

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## 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:** 04/10/2012

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Date

Oct. 04, 2012

SAR TEAM MANAGER

JS

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Technopôle Brest Iroise  
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## 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 M $\Omega$<br>Dipole 2: R2=1.4894 M $\Omega$<br>Dipole 3: R3=1.4683 M $\Omega$ |
| 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  |

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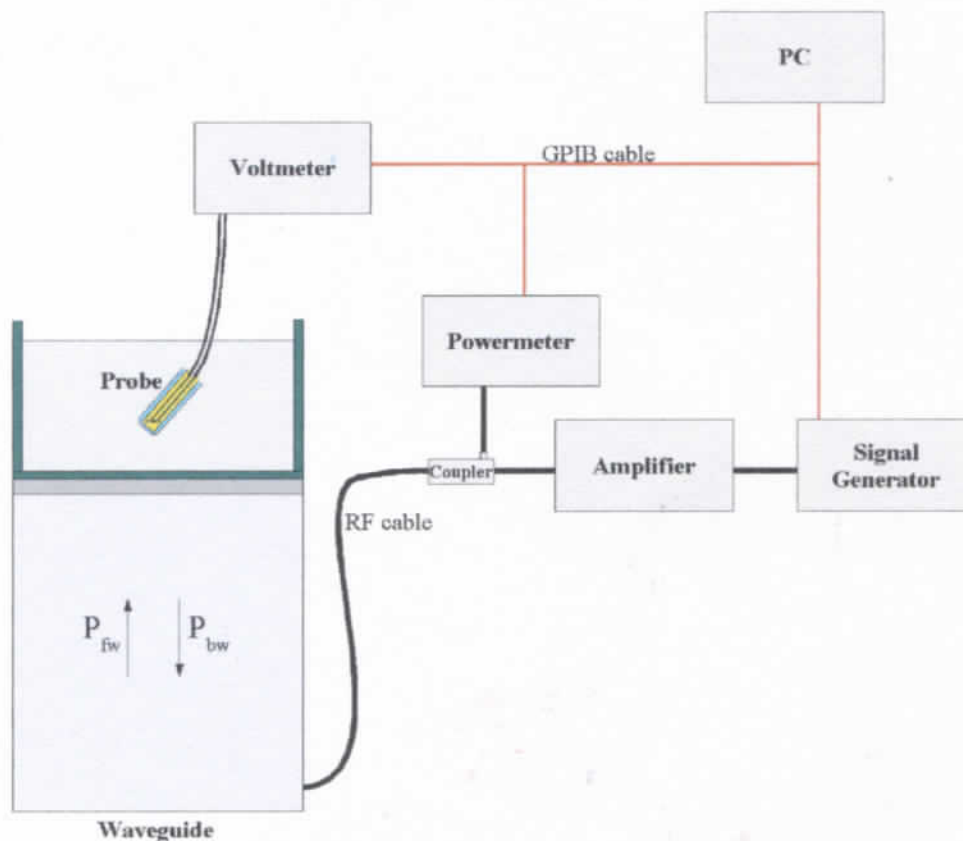
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## MEASUREMENT PROCEDURE

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.



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

Where :

- $P_{fw}$  = Forward Power
- $P_{bw}$  = Backward Power
- $a$  and  $b$  = Waveguide dimensions
- $\delta$  = 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.

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## 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%                   |
| <b>Combined standard uncertainty</b>                     |                       |                          |            |    | 4,761%                   |
| <b>Expanded uncertainty</b> (confidence interval of 95%) |                       |                          |            |    | 9,331%                   |

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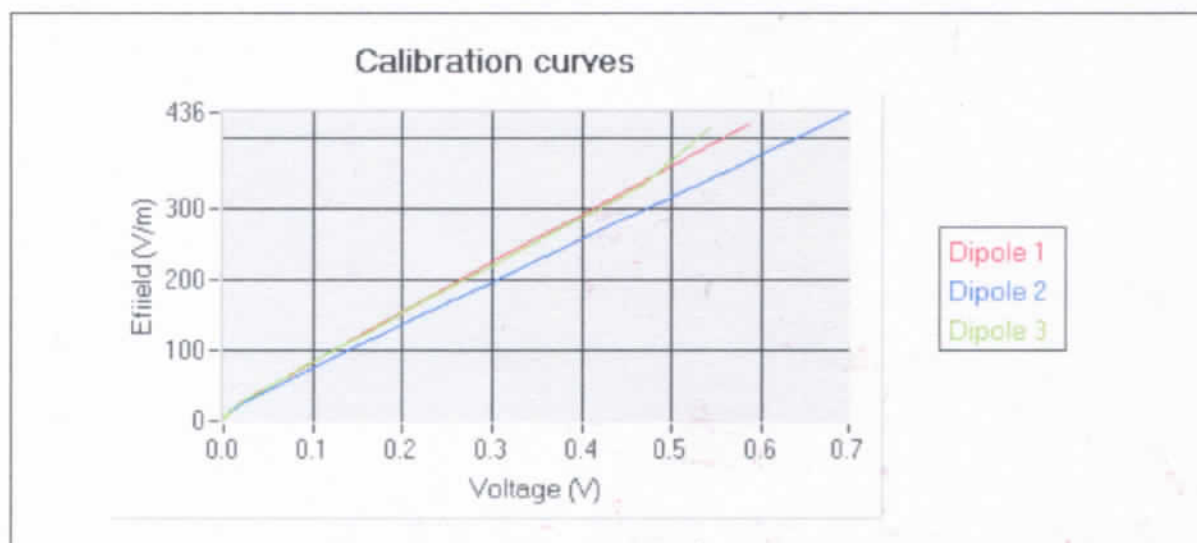
## 1. Calibration at 450.00 MHz

### A. Calibration parameters.

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

Calibration curves  $e_i=f(V)$  ( $i=1,2,3$ ) 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.



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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   |           |            |          |            |

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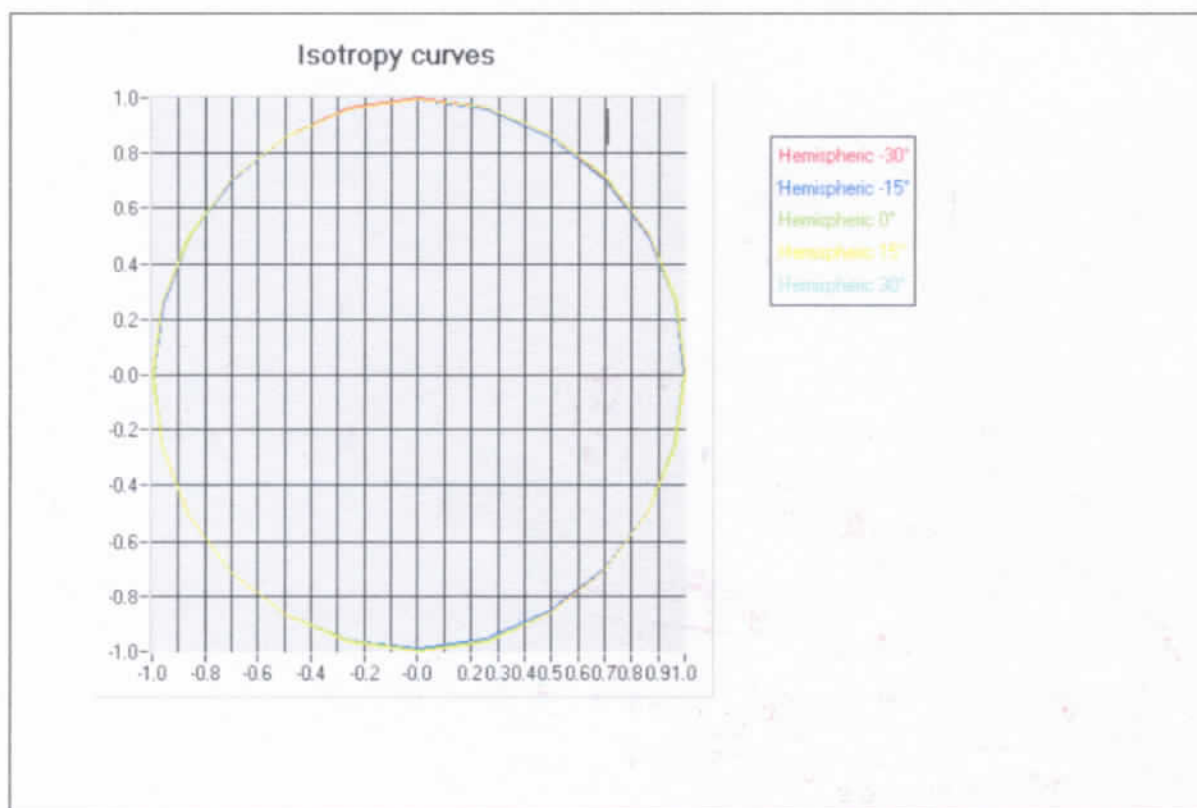
Date: 2011/10/04

Sensitivity in liquid:

| Liquid | $\epsilon$ | $\sigma$ | CF dipole 1<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ ) | CF dipole 2<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ ) | CF dipole 3<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ ) |
|--------|------------|----------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|
| 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



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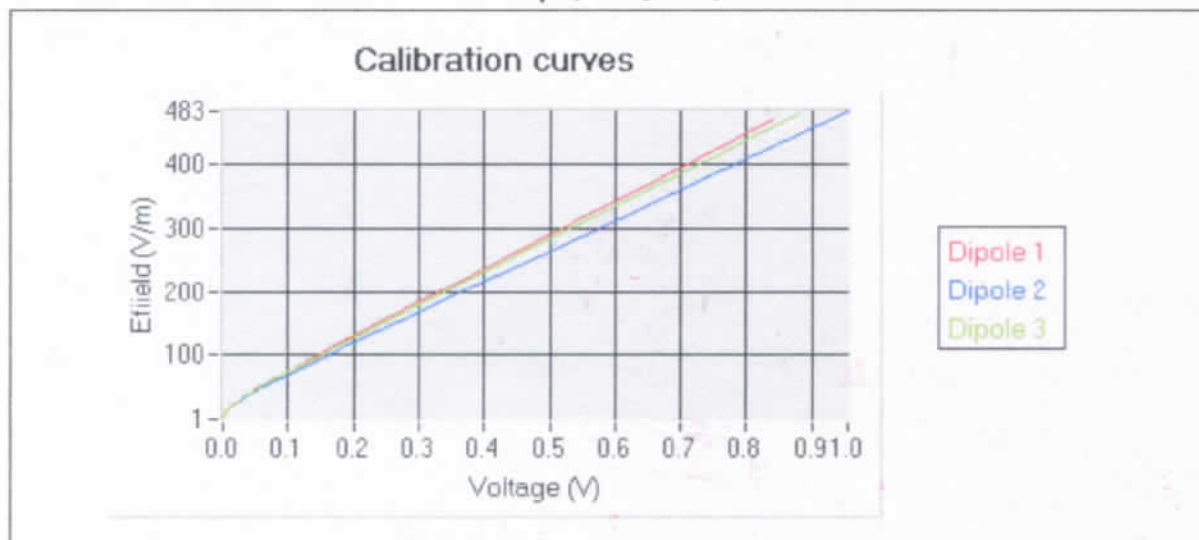
## 2. Calibration at 835.00 MHz

### A. Calibration parameters.

|                     |                       |
|---------------------|-----------------------|
| Label               | 850                   |
| Epsilon             | 43.40                 |
| Sigma               | 0.89 S/m              |
| Temperature         | 21°C                  |
| 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  $e_i=f(V)$  ( $i=1,2,3$ ) 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.

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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 | 89.957894  |
| 0.110307  | 80.730805  | -0.121434 | 80.730805  | 0.113306 | 80.730805  |
| 0.094797  | 72.200346  | -0.104643 | 72.200346  | 0.097445 | 72.200346  |
| 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 | 51.586883  |
| 0.049536  | 45.976857  | -0.055336 | 45.976857  | 0.051073 | 45.976857  |
| 0.041505  | 40.976917  | -0.046508 | 40.976917  | 0.042828 | 40.976917  |
| 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 | 14.623094  |
| 0.005549  | 13.017850  | -0.006351 | 13.017850  | 0.005768 | 13.017850  |
| 0.004461  | 11.628917  | -0.005124 | 11.628917  | 0.004648 | 11.628917  |
| 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   |          |            |

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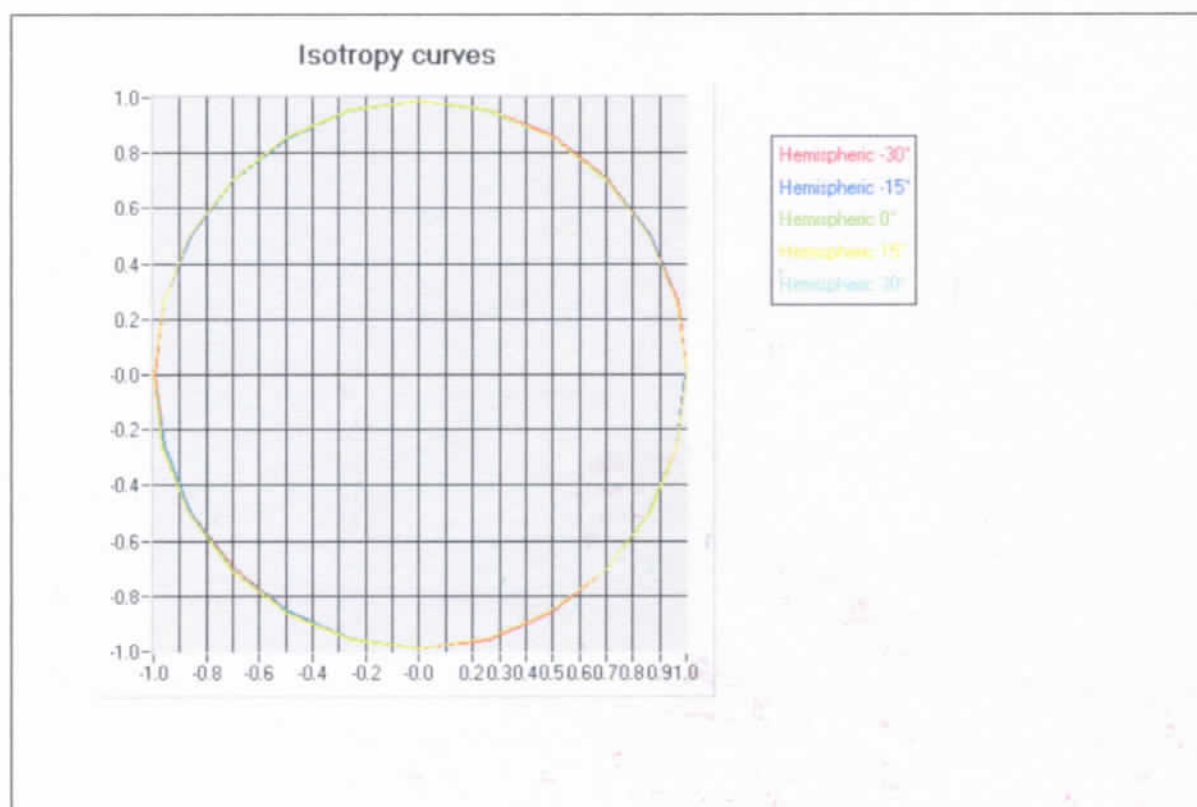
Date: 2012/10/04

Sensitivity in liquid:

| Liquid | $\epsilon$ | $\sigma$ | CF dipole 1<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) | CF dipole 2<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) | CF dipole 3<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) |
|--------|------------|----------|--------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|
| 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

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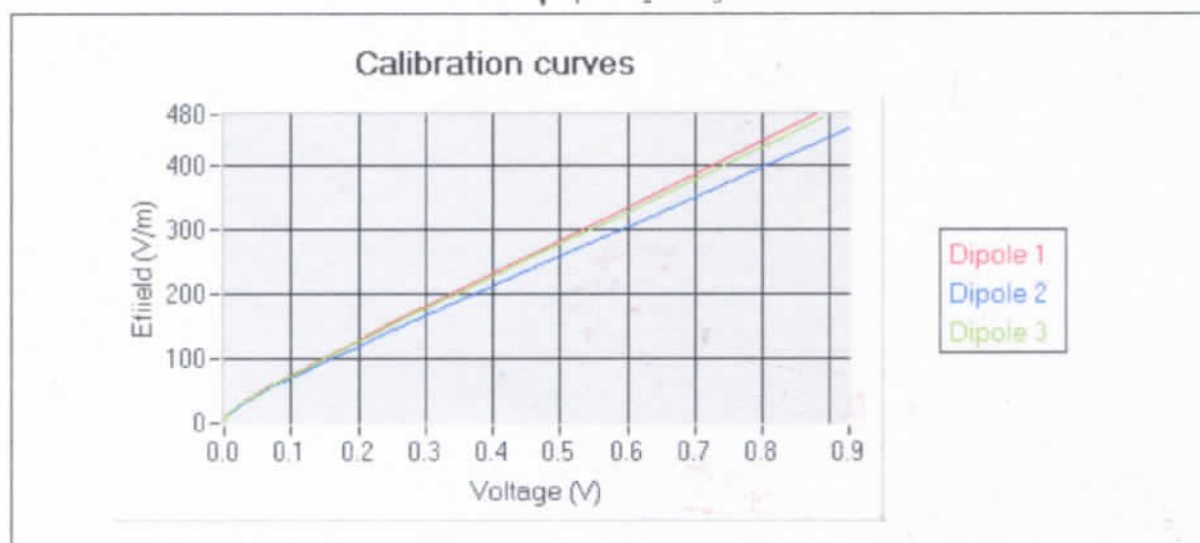
## 3. Calibration at 897.00 MHz

### A. Calibration parameters.

|                     |                       |
|---------------------|-----------------------|
| Label               | 900                   |
| Epsilon             | 42.58                 |
| Sigma               | 0.96 S/m              |
| Temperature         | 21°C                  |
| 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  $e_i=f(V)$  ( $i=1,2,3$ ) 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.



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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   |           |            |           |            |



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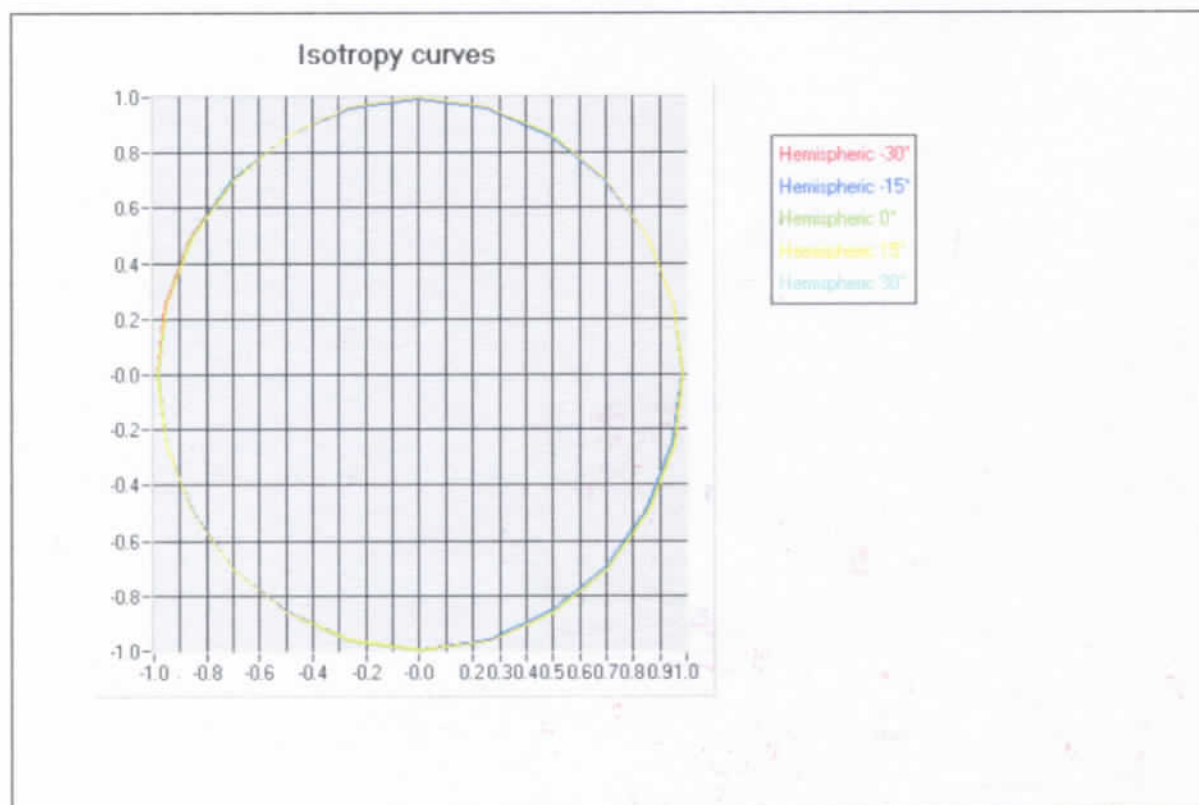
Date: 2012/10/04

Sensitivity in liquid:

| Liquid | $\epsilon$ | $\sigma$ | CF dipole 1<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) | CF dipole 2<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) | CF dipole 3<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) |
|--------|------------|----------|--------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|
| 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

# COMOSAR E-Field probe Calibration Report



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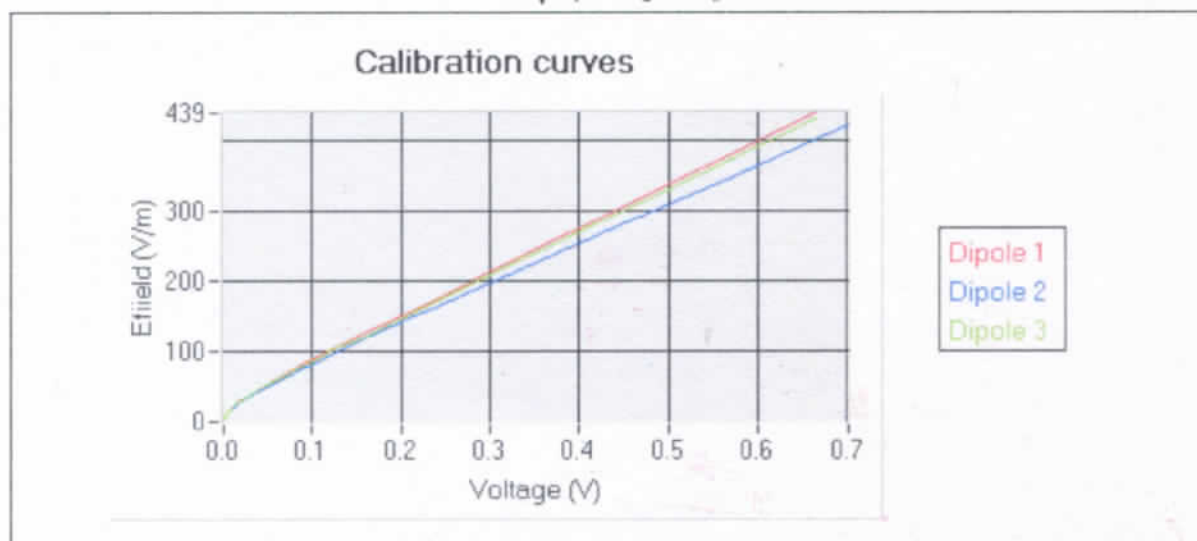
## 4. Calibration at 1747.00 MHz

### A. Calibration parameters.

|                     |                       |
|---------------------|-----------------------|
| Label               | 1800                  |
| Epsilon             | 40.09                 |
| Sigma               | 1.38 S/m              |
| Temperature         | 21°C                  |
| 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  $e_i=f(V)$  ( $i=1,2,3$ ) 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.

# COMOSAR E-Field probe Calibration Report



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Date: 2012/10/04

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   |

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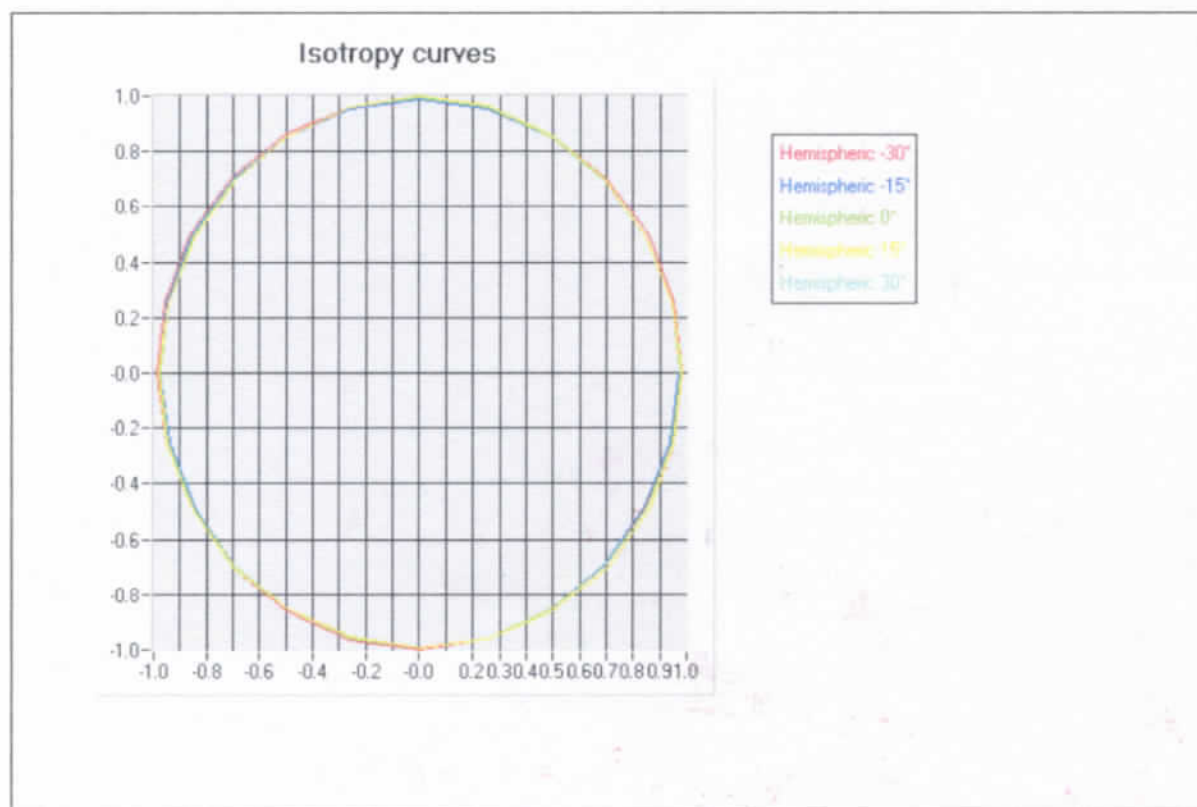
Date: 2012/10/04

Sensitivity in liquid:

| Liquid | $\epsilon$ | $\sigma$ | CF dipole 1<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) | CF dipole 2<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) | CF dipole 3<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) |
|--------|------------|----------|--------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|
| 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



# COMOSAR E-Field probe Calibration Report



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Date: 2012/10/4

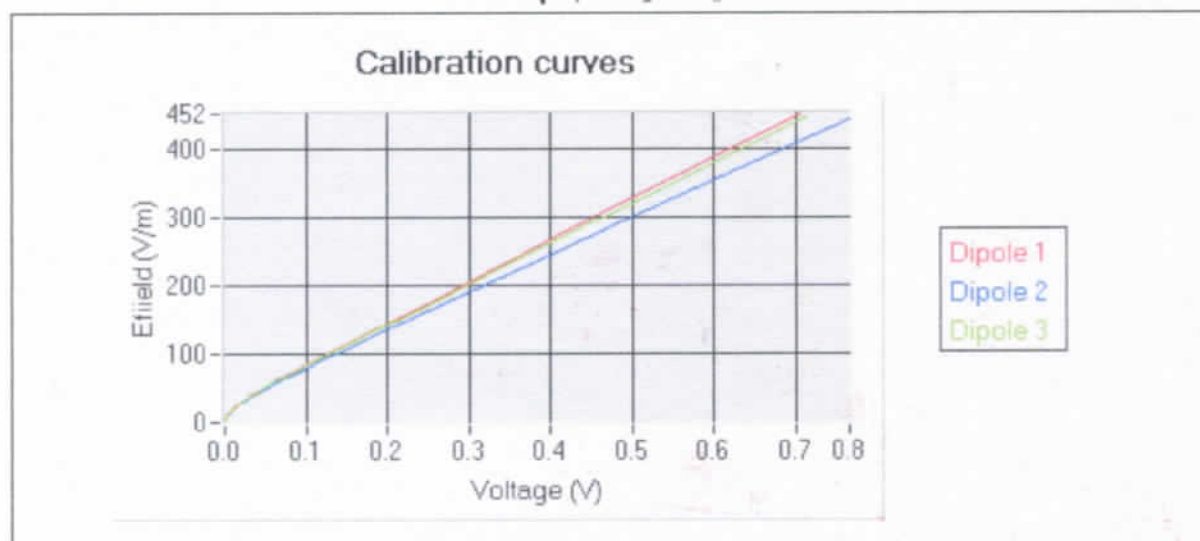
## 5. Calibration at 1880.00 MHz

### A. Calibration parameters.

|                     |                       |
|---------------------|-----------------------|
| Label               | 1900                  |
| Epsilon             | 39.68                 |
| Sigma               | 1.39 S/m              |
| Temperature         | 21°C                  |
| 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  $e_i=f(V)$  ( $i=1,2,3$ ) 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.

# COMOSAR E-Field probe Calibration Report



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Date: 2012/10/04

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   |           |            |           |            |

# COMOSAR E-Field probe Calibration Report



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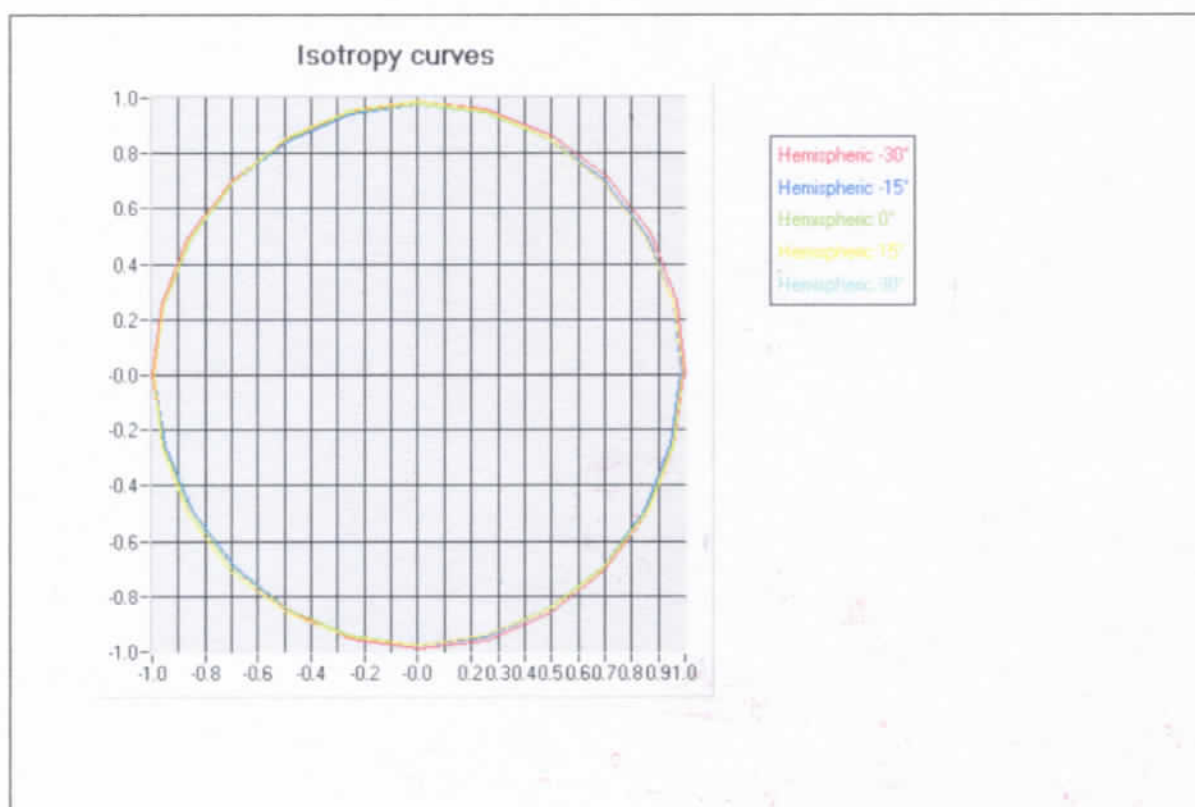
Date: 2012/10/04

Sensitivity in liquid:

| Liquid | $\epsilon$ | $\sigma$ | CF dipole 1<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) | CF dipole 2<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) | CF dipole 3<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) |
|--------|------------|----------|--------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|
| 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

# COMOSAR E-Field probe Calibration Report



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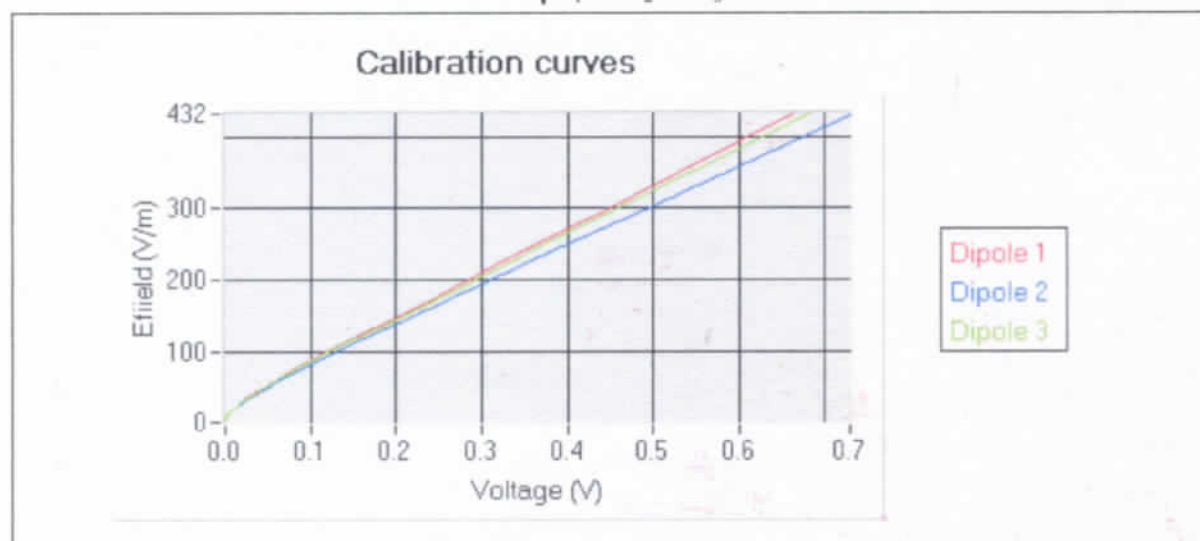
## 6. Calibration at 1950.00 MHz

### A. Calibration parameters.

|                     |                       |
|---------------------|-----------------------|
| Label               | 2000                  |
| Epsilon             | 39.69                 |
| Sigma               | 1.44 S/m              |
| Temperature         | 21°C                  |
| 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  $e_i=f(V)$  ( $i=1,2,3$ ) 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.



# COMOSAR E-Field probe Calibration Report



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Date: 2012/10/04

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   |           |            |

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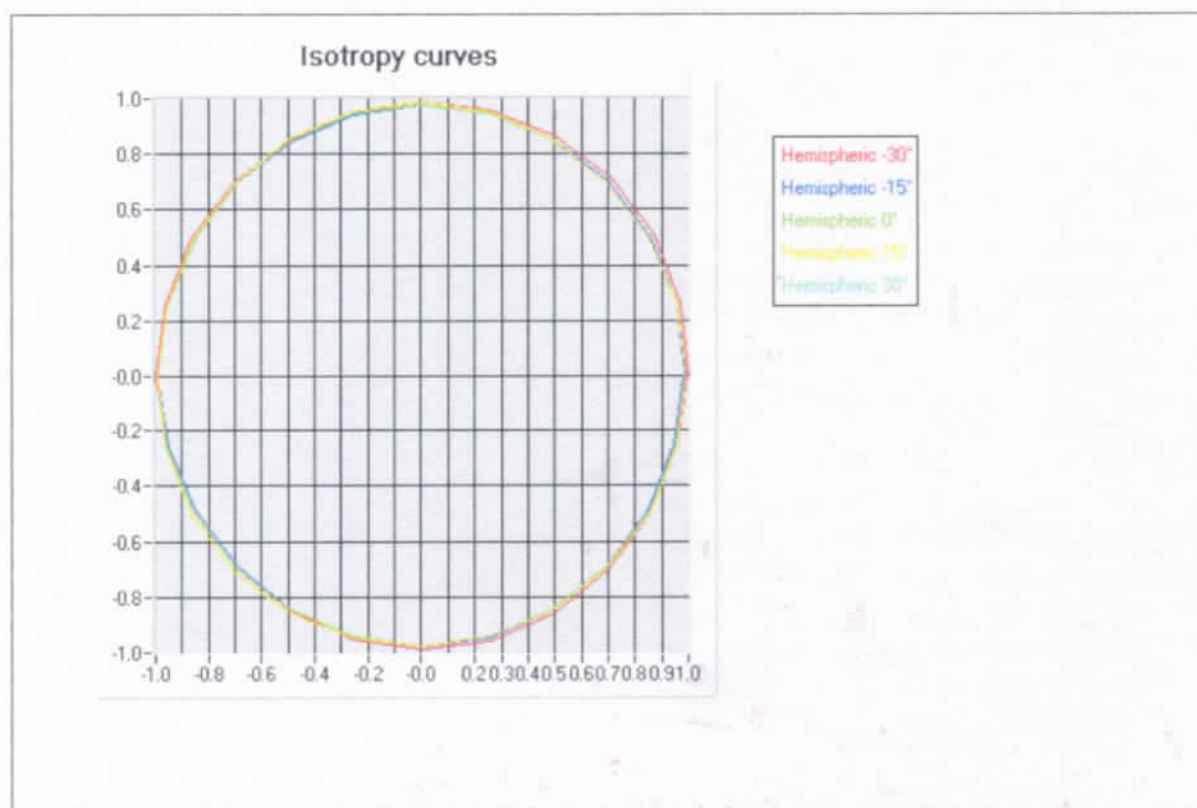
Date: 2012/10/04

Sensitivity in liquid:

| Liquid | $\epsilon$ | $\sigma$ | CF dipole 1<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) | CF dipole 2<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) | CF dipole 3<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ )) |
|--------|------------|----------|--------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|
| 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

# COMOSAR E-Field probe Calibration Report



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Date: 2012/10/04

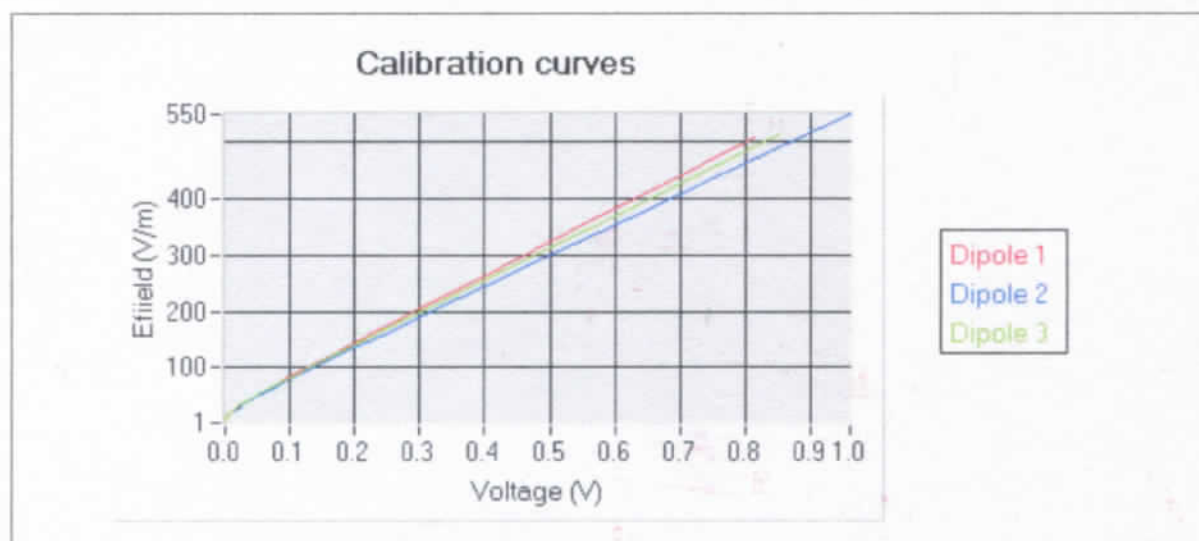
## 7. Calibration at 2450.00 MHz

### A. Calibration parameters.

|                     |                       |
|---------------------|-----------------------|
| Label               | 2450                  |
| Epsilon             | 37.93                 |
| Sigma               | 1.89 S/m              |
| Temperature         | 21°C                  |
| 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  $e_i=f(V)$  ( $i=1,2,3$ ) 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.



# COMOSAR E-Field probe Calibration Report



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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   |



# COMOSAR E-Field probe Calibration Report



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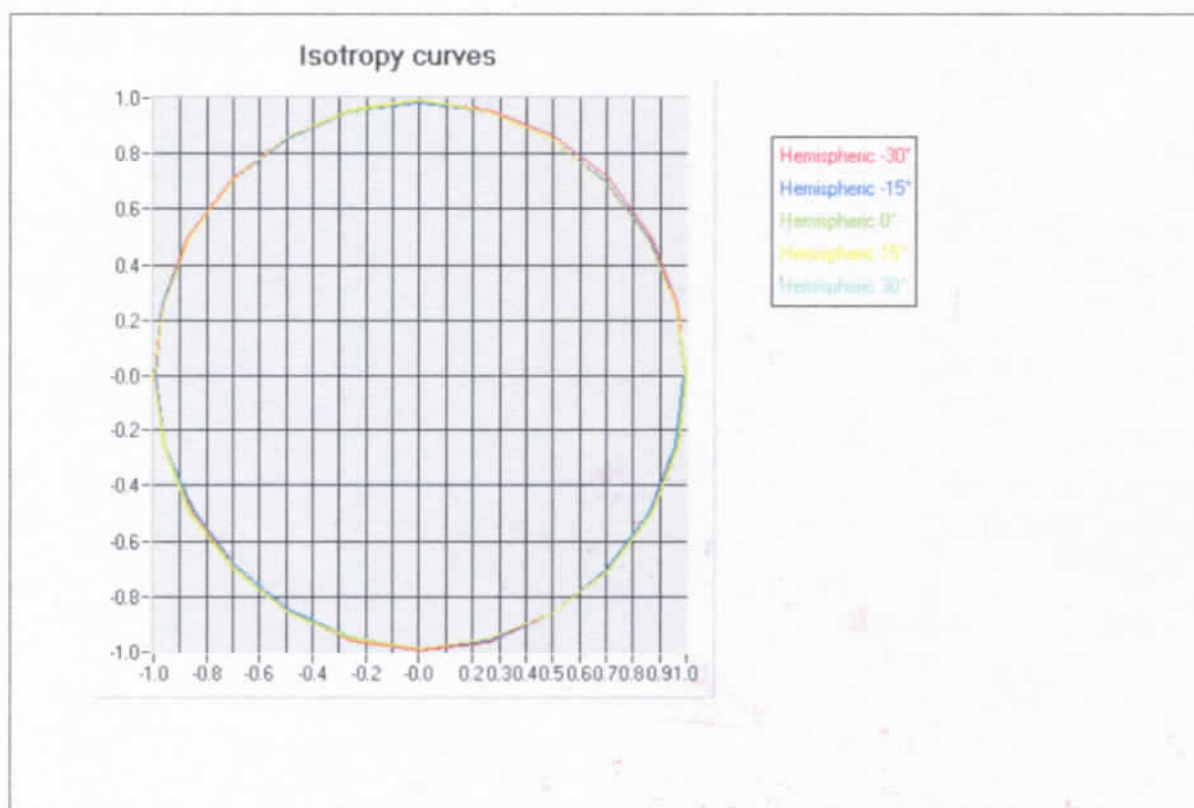
Date: 2012/10/04

Sensitivity in liquid:

| Liquid | $\epsilon$ | $\sigma$ | CF dipole 1<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ ) | CF dipole 2<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ ) | CF dipole 3<br>( $\text{W.kg}^{-1}$<br>( $\text{mV}^{-1}$ ) |
|--------|------------|----------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|
| 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