

COMOSAR E-Field probe Calibration Report



Ref: CR-131-1-09-SATB-B

Page: 1/17

Issue: B

Date: 2010/05/11

COMOSAR E-FIELD PROBE CALIBRATION REPORT

Prepared By: BUTET Romain, SATIMO
Project Description: COMOSAR E-FIELD PROBE
Prepared For (End User): CCS

This document is issued by SATIMO, in confidence and is not to be reproduced in whole or in part without the prior written permission. The information contained herein is to be used only for the purpose for which it is submitted and is not to be released in whole or in part without the prior written permission of SATIMO.

COMOSAR E-Field probe Calibration Report



Ref: CR-131-1-09-SATB-B

Page: 1/17

Issue: B

Date: 2010/05/11

COMOSAR SEPT ISOTROPIC E-FIELD PROBE CALIBRATION REPORT

DATE: 5/11/2010

OFFER REFERENCE: PF.127.1.09.SATB.B

OBJECT: COMOSAR SEPT ISOTROPIC E-FIELD PROBE

MANUFACTURER: SATIMO

SERIAL NUMBER: SN 11/09 EP100

CUSTOMER: CCS

CONTRACT: B01351

DATE OF CALIBRATION: 5/5/2010

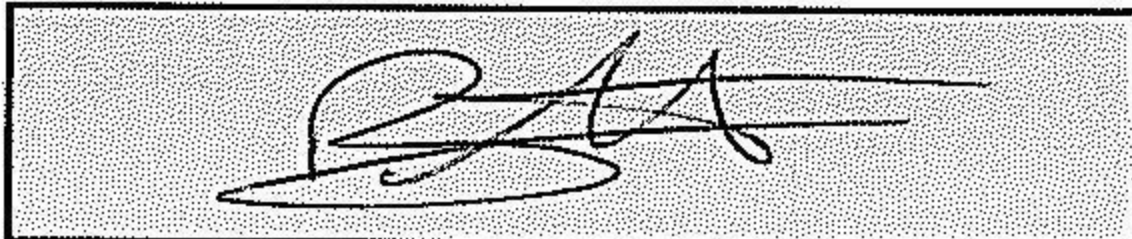
WARRANTY:

This Calibration certificate may not be reproduced other than in full. Calibration certificates without signature and seal are not valid. This documentation contains property information which is protected by copyright. All right are reserved. No part of this document may be photocopied, reproduced without the prior written agreement of SATIMO. SATIMO shall not be liable for errors contained herein or for incidental or consequential in connection with the furnishing, performance or use of this material. Warranty doesn't apply to Normal wear, Normal tear, Improper use, Improper maintain, Improper installation.

Date

11/05/2010

SAR TEAM MANAGER



COMOSAR E-Field probe Calibration Report



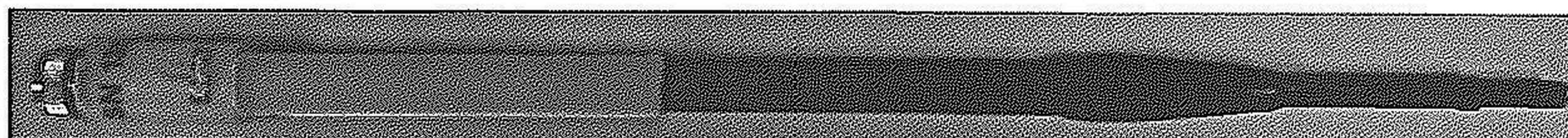
Ref: CR-131-1-09-SATB-B

Page: 1/17

Issue: B

Date: 2010/05/11

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=2.5307 MΩ Dipole 2: R2=2.6353 MΩ Dipole 3: R3=2.5471 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	DATE OF CALIBRATION
Calibration bench	CALISAR CALIBRATION SYSTEM V2.0	
Multimeter	Keithley (2000, SN: 1000572)	Date of calibration: 01-04-2010

COMOSAR E-Field probe Calibration Report



Ref: CR-131-1-09-SATB-B

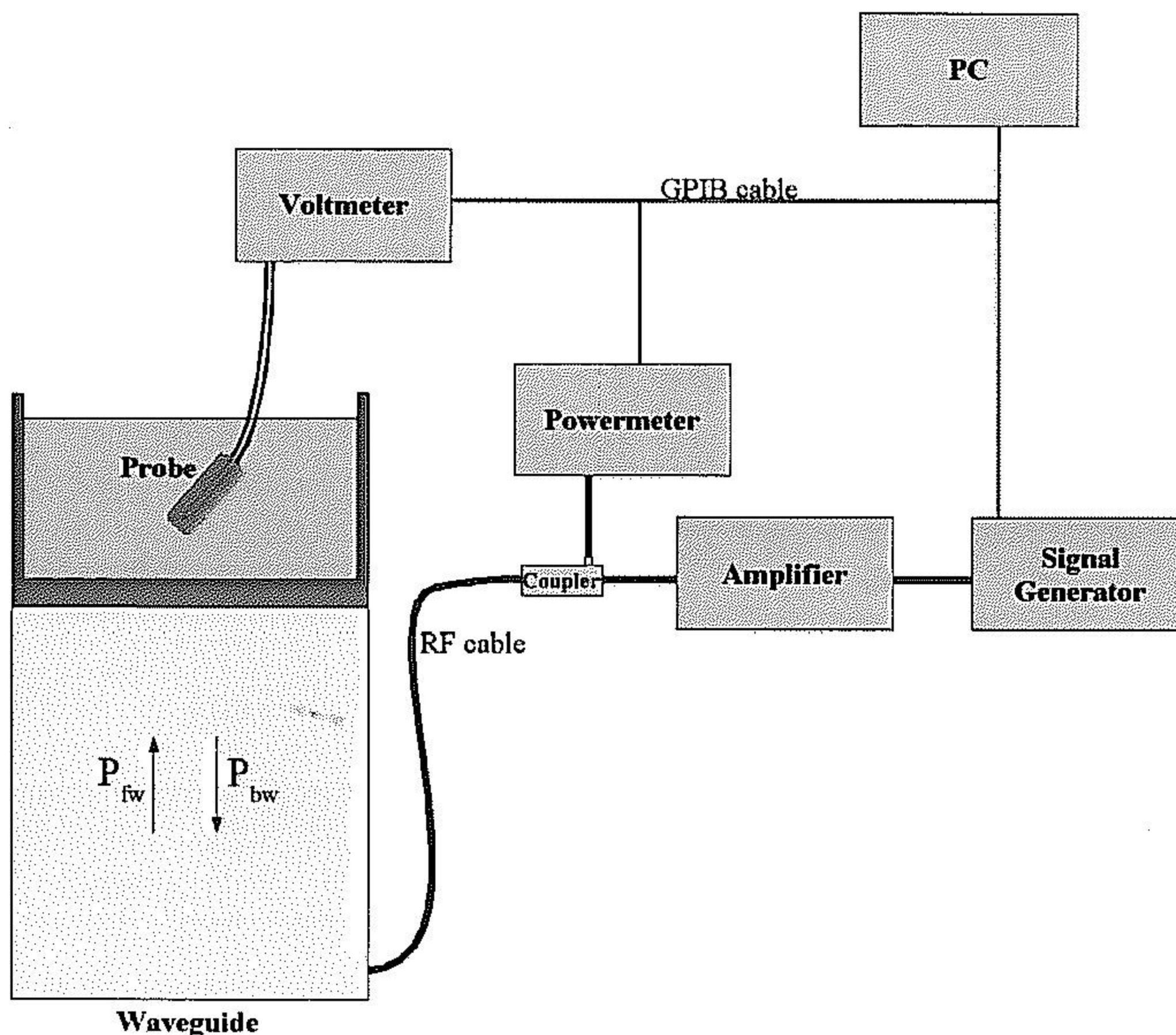
Page: 1/17

Issue: B

Date: 2010/05/11

MEASUREMENT PROCEDURE

Probe calibration is realized, in compliance with CENELEC EN 50361 and IEEE 1528 std, with CALISAR, SATIMO 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
- d = 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.

COMOSAR E-Field probe Calibration Report



Ref: CR-131-1-09-SATB-B

Page: 1/17

Issue: B

Date: 2010/05/11

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%

COMOSAR E-Field probe Calibration Report



Ref: CR-131-1-09-SATB-B

Page: 1/17

Issue: B

Date: 2010/05/11

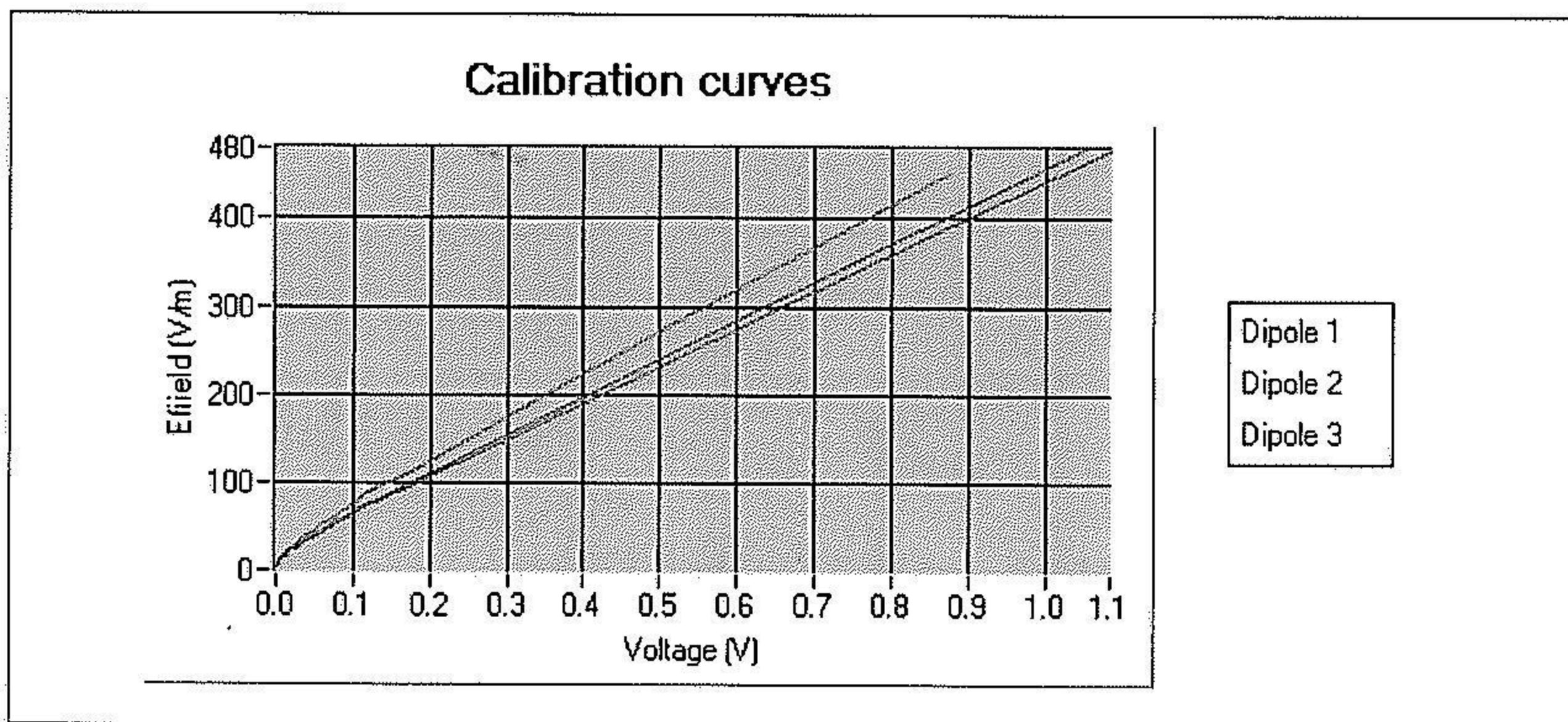
1. Calibration at 835.00 MHz

A. Calibration parameters.

Label	850
Epsilon	41.81
Sigma	0.88 S/m
Temperature	21°C
Cable loss	0.12 dB
Coupler loss	20.50 dB
Waveguide S11	-11.22 dB
Low limit detection	0.824 V/m (0.604 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



Ref: CR-131-1-09-SATB-B

Page: 1/17

Issue: B

Date: 2010/05/11

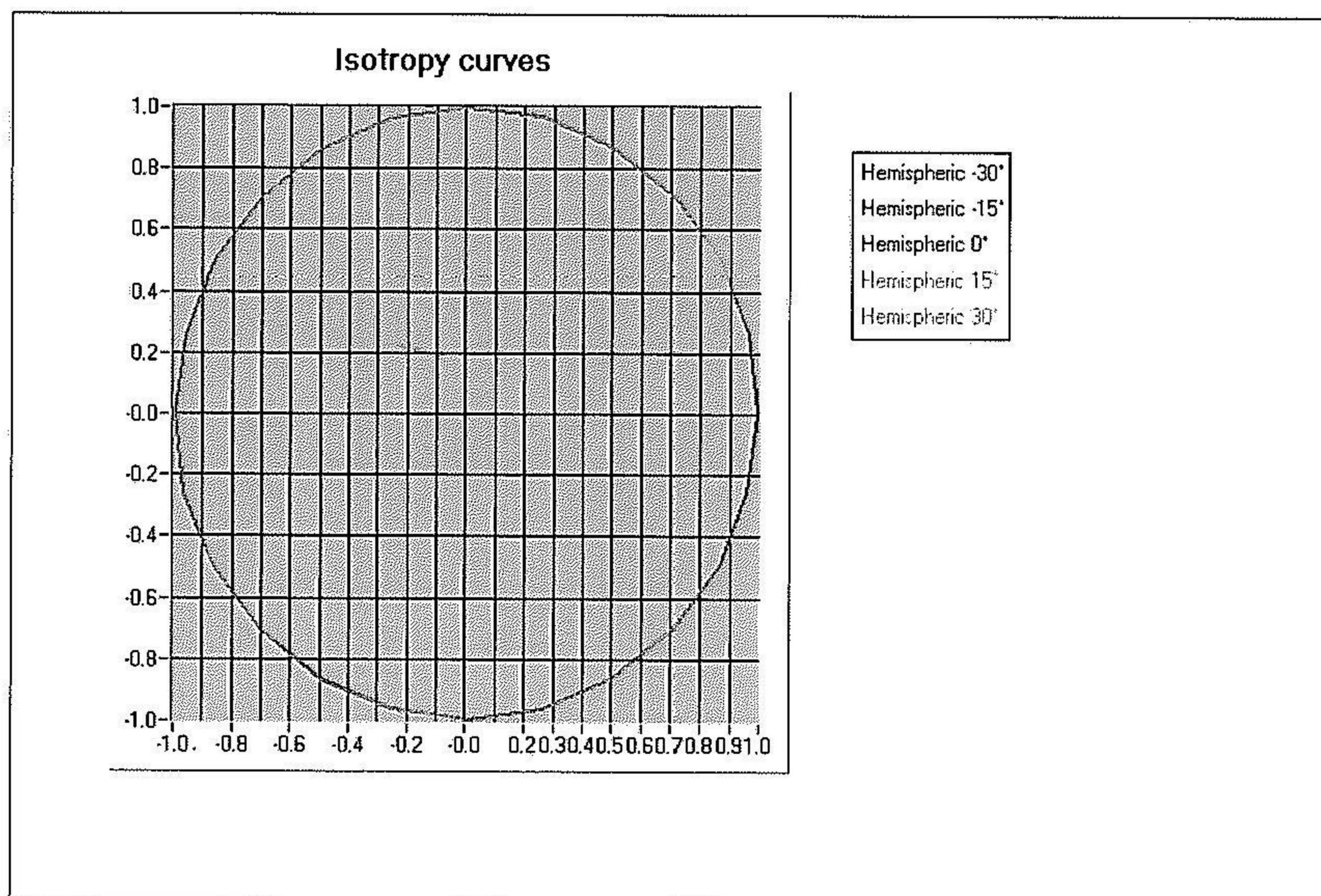
Calibration coefficients for the three dipoles in CW:

Sensitivity in liquid:

Liquid	Epsilon	Sigma (S/m)	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	41.81	0.90	20.66	20.51	28.36
Body	55.51	0.94	20.00	19.88	27.77

B. Isotropy.

- Axial isotropy: 0.029 dB
- Hemispherical isotropy: 0.030 dB



C. Linearity.

- Linearity:

0.04 dB

COMOSAR E-Field probe Calibration Report



Ref: CR-131-1-09-SATB-B

Page: 1/17

Issue: B

Date: 2010/05/11

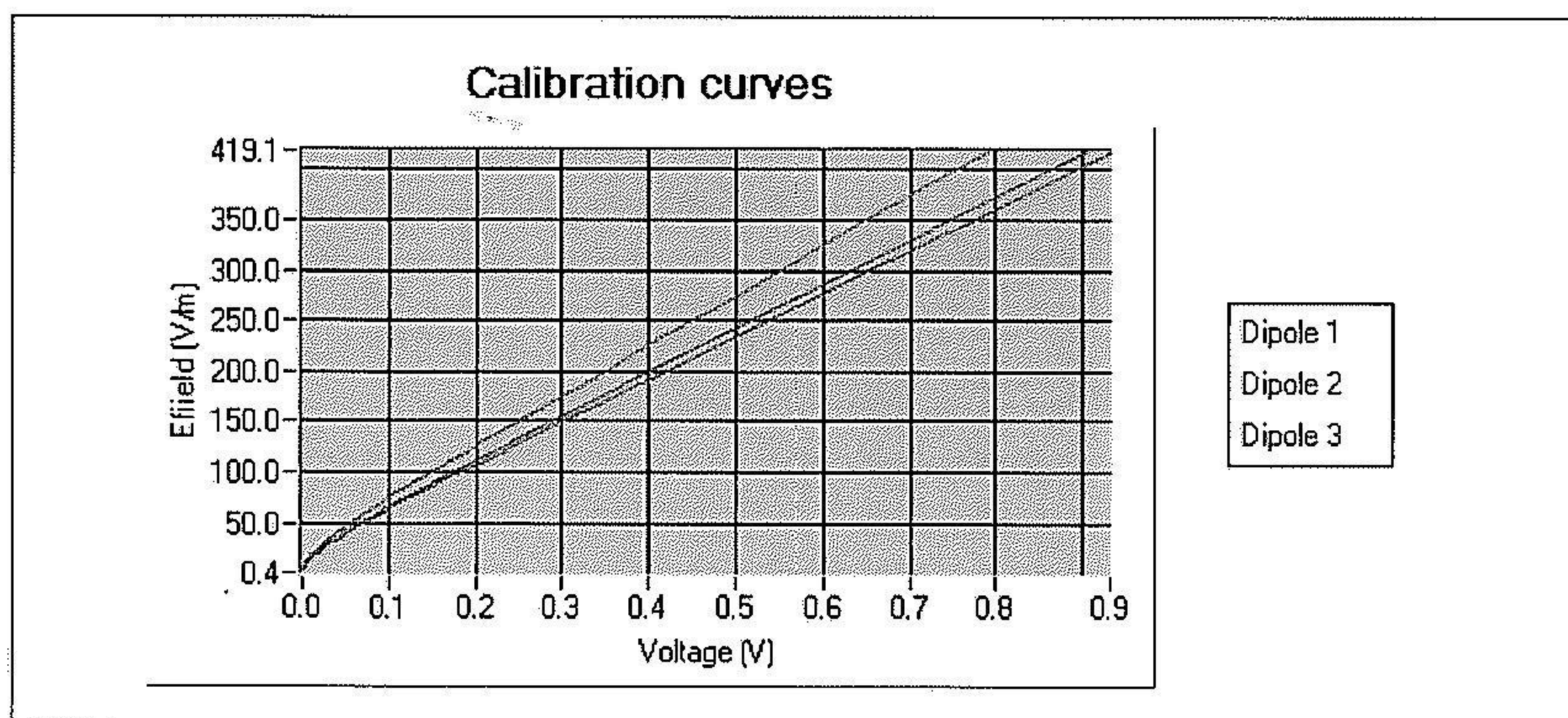
2. Calibration at 897.00 MHz

A. Calibration parameters.

Label	900
Epsilon	41.22
Sigma	0.91 S/m
Temperature	21°C
Cable loss	0.11 dB
Coupler loss	20.27 dB
Waveguide S11	-16.71 dB
Low limit detection	0.795 V/m (0.59 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



Ref: CR-131-1-09-SATB-B

Page: 1/17

Issue: B

Date: 2010/05/11

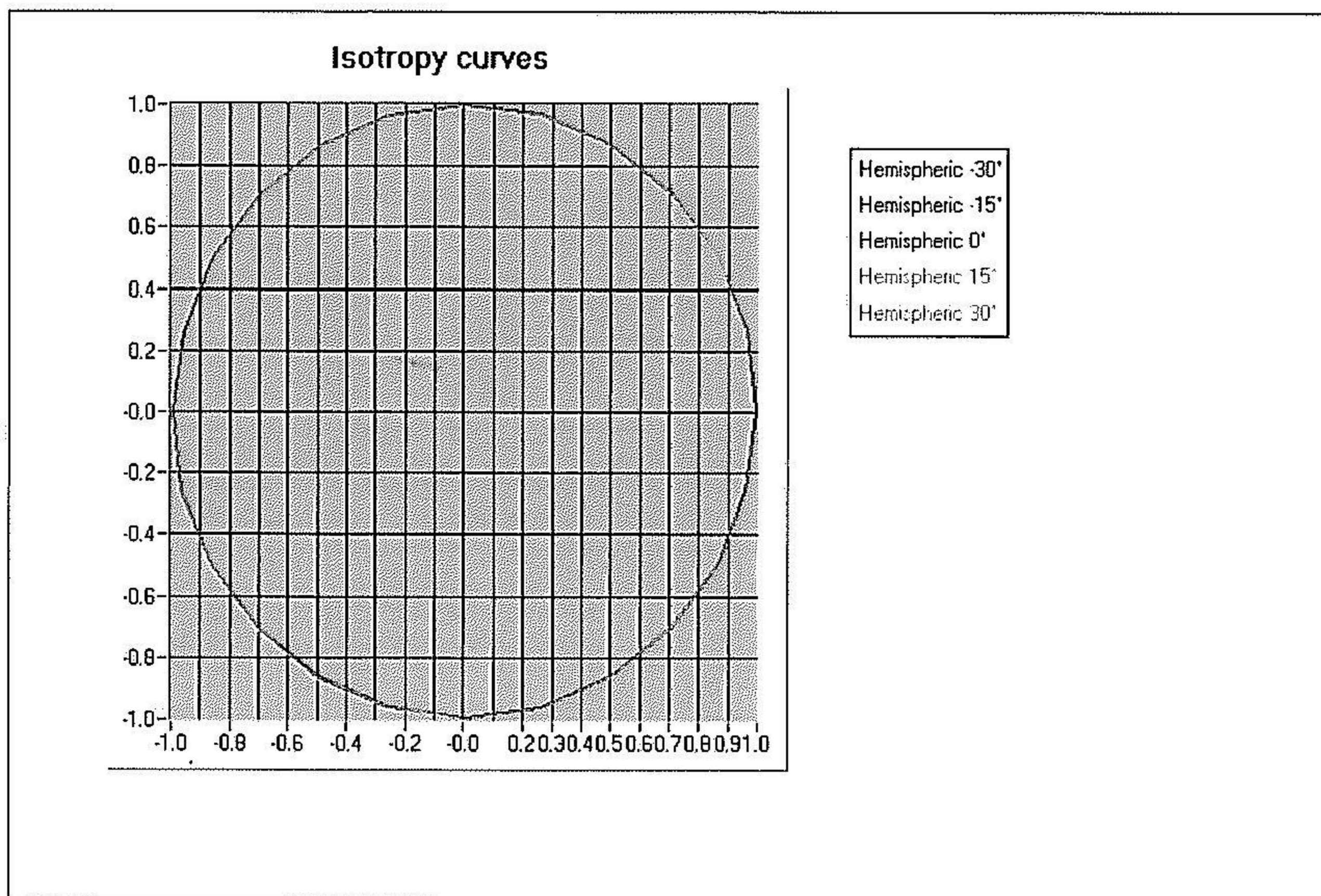
Calibration coefficients for the three dipoles in CW:

Sensitivity in liquid:

Liquid	Epsilon	Sigma (S/m)	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	41.24	0.94	22.06	22.01	30.16
Body	55.69	1.00	21.56	21.36	29.10

B. Isotropy.

- Axial isotropy: 0.029 dB
- Hemispherical isotropy: 0.030 dB



C. Linearity.

- Linearity: 0.04 dB

COMOSAR E-Field probe Calibration Report



Ref: CR-131-1-09-SATB-B

Page: 1/17

Issue: B

Date: 2010/05/11

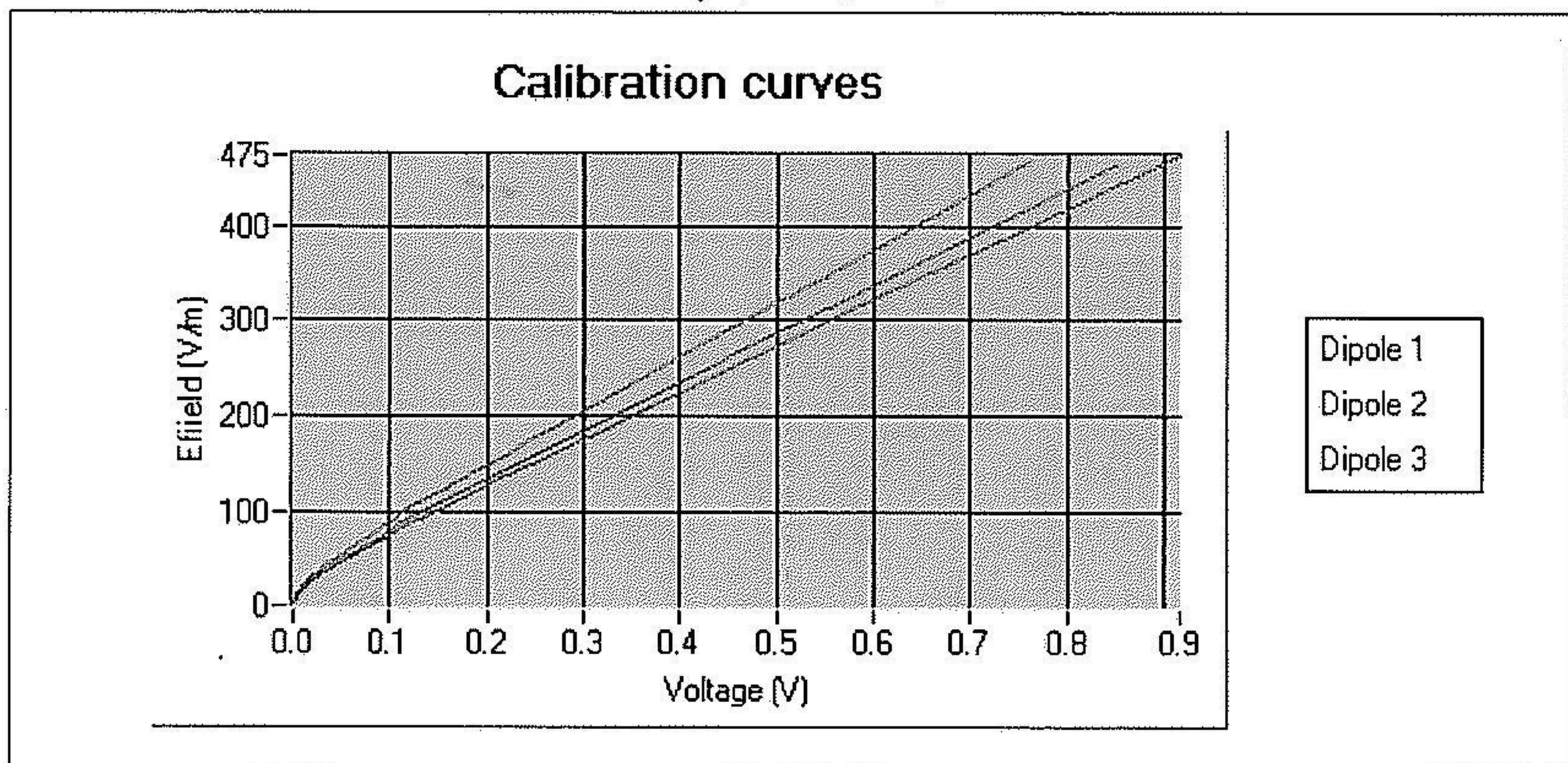
3. Calibration at 1747.00 MHz

A. Calibration parameters.

Label	1800
Epsilon	38.58
Sigma	1.33 S/m
Temperature	21°C
Cable loss	0.18 dB
Coupler loss	20.22 dB
Waveguide S11	-13.13 dB
Low limit detection	0.833 V/m (0.92 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.