SA à directoire et conseil de surveillance.
SIRET : 418 022 877 00033 – RCS BREST
Bâtiment Ponant, Avenue La Pérouse, Technopole Brest-Iroise – 29280 PLOUZANE – France.

ACCEPTANCE TEST

ANNEX A

PROBE SN01/06 EP45 CALIBRATION

Prepared By: Mr. LUC Jérôme, ANTENNESSA

Project Description : SAR TEST BENCH

Prepared For (End User) : CCS

COMOSAR SEPT ISOTROPIC E-FIELD PROBE CALIBRATION REPORT

DATE : 06/01/2006

REFERENCE: SN 01/06 EP45

OBJECT : COMOSAR SEPT ISOTROPIC E-FIELD PROBE

MANUFACTURER : ANTENNESSA

SERIAL NUMBER : SN 01/06 EP45

CUSTOMER : CCS

ORDER : PF05120023

DATE OF CALIBRATION : 04/01/2006

WARRANTY :

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Date

06-01-06

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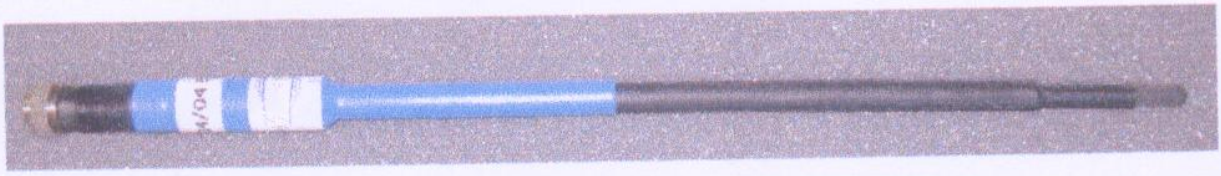
SAR TEAM MANAGER

PRESIDENT

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=1.5304 MΩ Dipole 2: R2=1.1400 MΩ Dipole 3: R3=1.6359 MΩ
Connector (HIROSE series SR30)	6 wire male (Hirose SR30series)

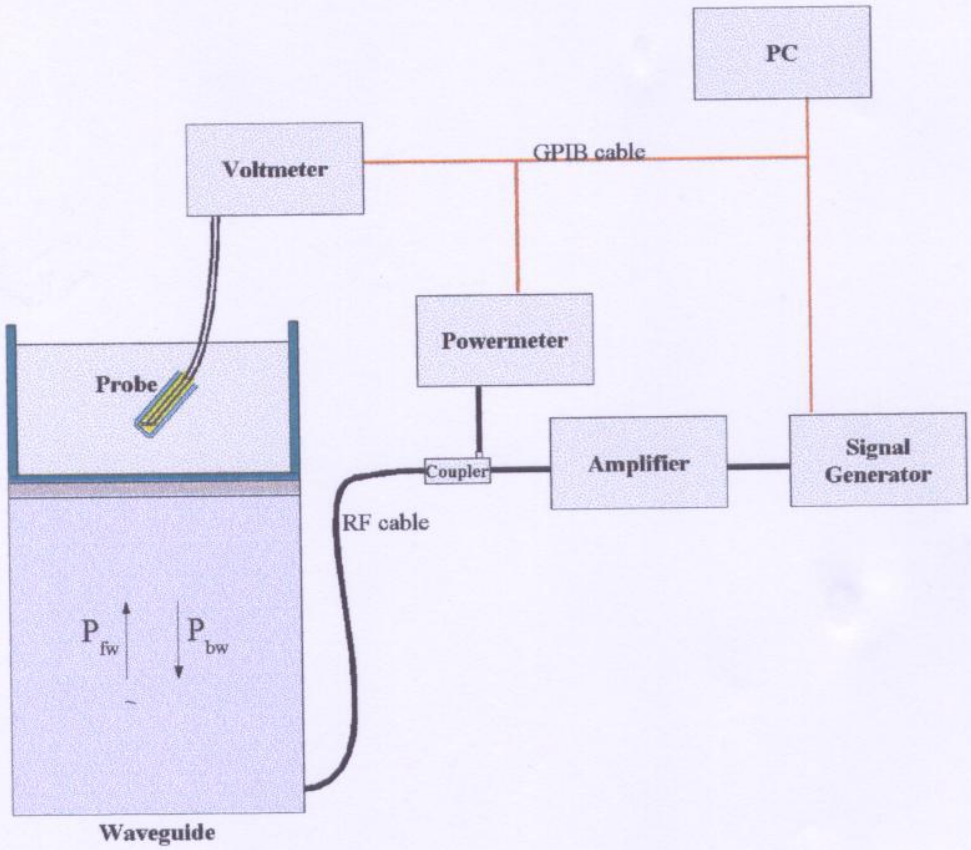
The probe could be checked by mesuring the resistance of the three dipoles.

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
δ	= 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 Antennessa probe

Uncertainty analysis for the evaluation of reference antenna gain

ERROR SOURCES	Description (Section)	Uncertainty value (%)	Probability Distribution	Divisor	ci	Standard Uncertainty (%)
Incident Power	B.2.2	0,20%	Rectangular	$\sqrt{3}$	1	0,115%
Reflection coefficients	B.2.2	0,75%	Rectangular	$\sqrt{3}$	1	0,433%
Distance	B.2.2	2,50%	Rectangular	$\sqrt{3}$	1	1,443%
Liquid Permittivity	B.2.2	3,00%	Rectangular	$\sqrt{3}$	1	1,732%
Combined standard uncertainty	B.2.2					2,299%
Expanded uncertainty (confidence interval of 95%)	B.2.2					4,506%

Uncertainty analysis for the technique using reference antennas

ERROR SOURCES	Description (Section)	Uncertainty value (%)	Probability Distribution	Divisor	ci	Standard Uncertainty (%)
Incident Power	B.2.2	0,20%	Rectangular	$\sqrt{3}$	1	0,200%
Reflection coefficients	B.2.2	0,75%	Rectangular	$\sqrt{3}$	1	0,433%
Antenna Gain	B.2.2	2,50%	Normal	1	1	2,500%
Liquid Permittivity	B.2.2	3,00%	Rectangular	$\sqrt{3}$	0	1,732%
Probe Positioning	B.2.2	2,50%	Rectangular	$\sqrt{3}$	1	1,443%
Combined standard uncertainty	B.2.2					2,926%
Expanded uncertainty (confidence interval of 95%)	B.2.2					5,735%

Uncertainty on measurement system

ERROR SOURCES	Description (Section)	Uncertainty value (%)	Probability Distribution	Divisor	ci	Standard Uncertainty (%)
Probe Calibration	7.2.1.	5,73%	Normal	1	1	5,735%
Axial Isotropy	7.2.1.	5,00%				
Hemispherical Isotropy	7.2.1.	10,00%				
Total Isotropy	7.2.1.	7,50%	Rectangular	$\sqrt{3}$	1	4,330%
Linearity	7.2.1.	4,60%	Rectangular	$\sqrt{3}$	1	2,656%
Detection Limits	7.2.1.	0,50%	Rectangular	$\sqrt{3}$	1	0,289%
Boundary Effect	7.2.1.	0,50%	Rectangular	$\sqrt{3}$	1	0,289%
Readout Electronics	7.2.1.	0,02%	Normal	1	1	0,020%
Response Time	7.2.1.	0,50%	Normal	1	1	0,500%
Noise	7.2.1.	0,50%	Normal	1	1	0,500%
Integration Time	7.2.1.	0,50%	Normal	1	1	0,500%
Combined standard uncertainty						7,721%
Expanded uncertainty (confidence interval of 95%)						15,132%

CALIBRATION @ 2450 MHz

Calibration parameters

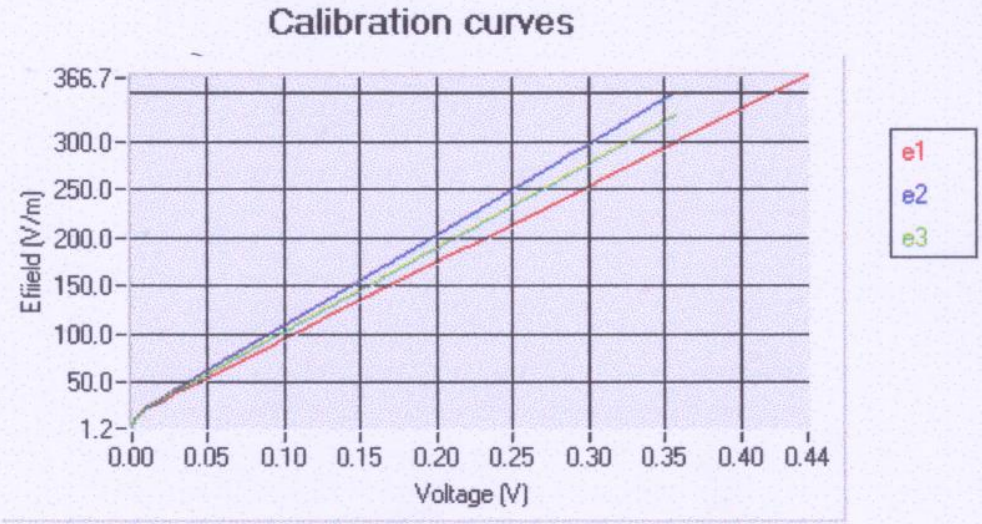
Label	Bluetooth2450
Epsilon	38.59
Sigma	1.71 S/m
Temperature	21 °C
Cable loss	3.30 dB
Coupler loss	21.50 dB
Waveguide S11	-11.70 dB
Low limit detection (CW)	2.16 V/m

Calibration curves

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 show the calibration curves linearisation by curve segment in CW and TDMA signal. TDMA coefficients have been calculated from CW coefficients using the formula:

Etdma(V)=1/8*(Ecw(V*8))

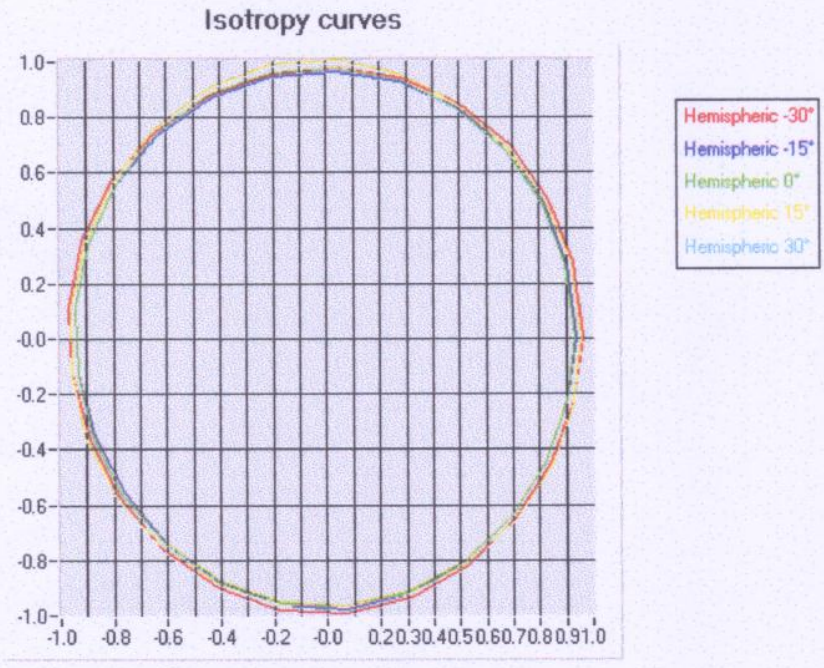


Calibration coefficients for the three dipoles in CW:

v1	e1	v2	e2	v3	e3
0.331523	306.842468	0.326012	354.721771	0.326263	332.115631
0.252046	237.077667	0.246535	272.237000	0.275022	282.456696
0.190897	183.399857	0.185386	208.772293	0.228393	237.266754
0.123124	123.908760	0.117613	138.434387	0.151276	162.529892
0.032362	44.210320	0.026851	44.210320	0.066804	80.665092
0.026892	39.493320	0.022182	39.447880	0.029269	44.261246
0.022100	35.198460	0.018172	35.198460	0.024259	39.493320
0.017775	31.047285	0.014543	31.011562	0.019922	35.198460
0.013999	27.165873	0.011410	27.165873	0.015993	31.047285
0.011090	23.934462	0.009013	23.934462	0.012569	27.197166
0.008847	21.184765	0.007149	21.184765	0.009933	23.934462
0.007091	18.859217	0.005723	18.859217	0.007907	21.184765
0.005693	16.847042	0.004586	16.847042	0.006339	18.859217
0.004596	15.101624	0.003700	15.101624	0.005074	16.847042
0.003721	13.568244	0.002992	13.568244	0.004102	15.101624
0.002989	12.218662	0.002423	12.218662	0.003310	13.568244
0.002437	11.028683	0.001965	11.028683	0.002689	12.218662
0.001946	9.920273	0.001592	9.920273	0.002177	11.028683
0.001485	8.680079	0.001185	8.680079	0.001754	9.920273
0.001111	7.629984	0.000891	7.638774	0.001320	8.680079
0.000865	6.753419	0.000685	6.753419	0.000993	7.629984
0.000649	6.005147	0.000517	6.005147	0.000755	6.745648
0.000471	5.364430	0.000388	5.364430	0.000564	6.005147
0.000355	4.808655	0.000308	4.808655	0.000433	5.358259
0.000263	4.320397	0.000232	4.320397	0.000299	4.808655
0.000191	3.890663	0.000175	3.895145	0.000241	4.315425
0.000126	3.519846	0.000121	3.515796	0.000169	3.890663
0.000081	3.173391	0.000075	3.177047	0.000121	3.511751
0.000042	2.776666	0.000040	2.783066	0.000079	3.177047
0.000018	2.449197	-0.000017	2.112706	0.000039	2.776666
0.000001	2.495896	-0.000030	1.923197	-0.000012	2.446378
-0.000012	2.371874	-0.000032	1.891552	-0.000029	2.169821
-0.000014	2.351701	-0.000059	1.409006	-0.000042	2.006022
-0.000041	2.067210	0.000000	0.000000	-0.000044	1.978931
-0.000116	0.882160	0.000000	0.000000	-0.000113	0.513818

Isotropy:

- Axial isotropy: 0.13 dB
- Hemispherical isotropy: 0.23 dB



E-field E (V/m)= f (phi, theta)