Accredited testing laboratory

DAR registration number: DAT-P-176/94-D1

Federal Motor Transport Authority (KBA)
DAR registration number: KBA-P 00070-97

Test report no.	**: 4-1832-01-01/05**
Type identification	**: CF62T**
Test specification	**: ANSI PC-63.19-2005**
FCC-ID	**: PWX-CF62T**

Table of Contents

1 General Information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in 1.5. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM ICT Services GmbH.

1.1.1 Statement of Compliance

The CF62T TripleBand Mobile Phone has been tested in accorance with ANSI C63.19-2005: American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids.

C63.19 HAC Rated Category : M3

The measurement together with the test system set-up is described in chapter 2.3 of this test report. A detailed description of the equipment under test can be found in chapter 1.5.

Test engineer:

2005-10-05	**Thomas Vogler**	Thomas Vogler
Date	Name	Signature

Technical responsibility for area of testing:

2005-10-05	**Bernd Rebmann**	B. Rebmann
Date	Name	Signature

1.2 Testing laboratory

CETECOM ICT Services GmbH
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66117 Saarbruecken
Germany
Telephone: + 49 681 598 - 0
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Internet: http://www.cetecom-ict.de

State of accreditation: The Test laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025. DAR registration number: DAT-P-176/94-D1

Test location, if different from CETECOM ICT Services GmbH

Name:
Street:
Town:
Country:
Phone:
Fax:

1.3 Details of applicant

Name: Siemens ICM

Street: 16475 San Bernardo Drive
Town: San Diego CA 92127
Country: Germany

Contact: Mr. Kevin Wolentarski
Telephone: +1 858-521-3352

1.4 Application details

Date of receipt of application:	2005-09-15
Date of receipt of test item:	2005-09-26
Start/Date of test:	2005-09-26
End of test:	
Person(s) present during the test:	---

1.5 Test item

Description of the test item:	Triple Band Mobile Phone
Type identification:	CF62T
FCC-ID :	PWX-CF62T
Serial number:	00-4999-00-309725-9

Manufacturer:

Name:	Siemens AG
Street:	Südstraße 9
Town:	47475 Kamp-Lintfort
Country:	Germany

additional information on the DUT:			
device type :	portable device		
IMEI No :	00-4999-00-309725-9		
exposure category:	uncontrolled environment / general population		
test device production information	identical prototype		
device operating configurations :			
operating mode(s)	GSM, DCS, PCS		
modulation	GMSK		
GPRS mobile station class :	B		
GPRS multislot class :	10		
maximum no. of timeslots in uplink :	2		
GPRS voice mode	no		
EGPRS multislot class	---		
operating frequency range(s)	PCS 1900 (tested)	DCS 1800	GSM 900
- transmitter frequency range :	1850.2 MHz ~ 1909.8 MHz	1710 MHz ~ 1785 MHz	880 MHz ~ 915 MHz
- receiver frequency range :	1930.2 MHz ~ 1989.8 MHz	1805 MHz ~ 1880 MHz	925 MHz ~ 960 MHz
Power class :	1, tested with power level 0 (1900 MHz band) 4, tested with power level 5 (850 MHz band)		
measured peak output power (conducted):	1900 band: 29.7 dBm		
test channels (low – mid – high) :	512 – 661 – 810 (1900 MHz band)		
antenna type :	integrated antenna		
battery options :	standard battery V30145-K1310-X277 (3.7 V / 750 mAh)		

1.6 Test specification(s)

ANSI-PC63.19-2005: American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids

FCC 47 CFR §20.19 : Hearing Aid-Compatible Mobile Headsets

1.6.1 Categories of Hearing Aid Compatibility for wireless devices

Telephone RF Parameters					
Category	AWF (dB)	Limits for E-Field Emissions		Limits for H-Field Emissions	
		V/m	dBV/m	A/m	dBA/m
M1	0	199.5 – 354.8	46 – 51	0.6 – 1.07	-4.4 – 0.6
	-5	149.6 – 266.1	43.5 – 48.5	0.45 – 0.8	-6.9 – -1.9
M2	0	112.2 – 199.5	41 – 46	0.34 – 0.6	-9.4 – -4.4
	-5	84.1 – 149.6	38.5 – 43.5	0.25 – 0.45	-11.9 – -6.9
M3	0	63.1 – 112.2	36 – 41	0.19 – 0.34	-14.4 – -9.4
	-5	47.3 – 84.1	33.5 – 38.5	0.15 – 0.25	-16.9 – -11.9
M4	0	<63.1	<36	<0.19	< -14.4
	-5	<47.3	<33.5	<0.14	< -16.9

AWF : Articulation Weighing Factor

Standard	Technology	AWF
TIA/EIA 553-A	Analog	0
IS-95	CDMA	0
IS-136	TDMA (50 Hz)	0
J-STD-007	**GSM (217 Hz)**	**-5**

2 Technical test

2.1 Summary of test results

No deviations from the technical specification(s) were ascertained in the course of the tests performed.	☒
HAC-Category : M3	
The deviations as specified in 2.5 were ascertained in the course of the tests performed.	☐

2.2 Test environment

General Environment conditions in the test area are as follows :

Ambient temperature:	20°C – 24°C
Tissue simulating liquid:	20°C – 24°C
Humidity:	40% – 50%

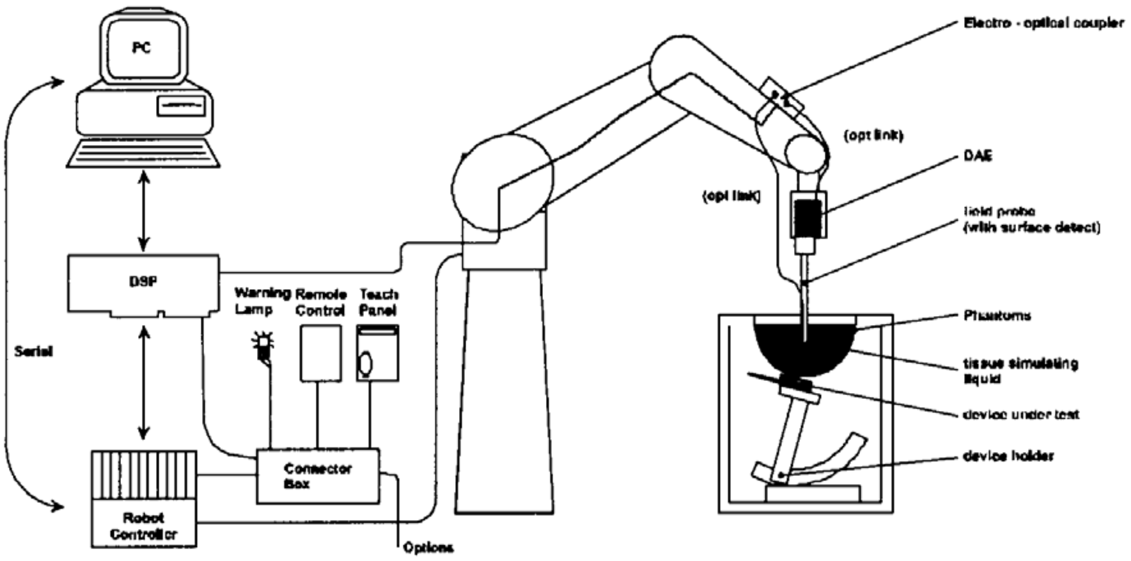
2.3 Measurement and test set-up

The measurement system is described in chapter 2.4.

A description of positioning and test signal control can be found in chapter 2.5 together with the test results.

2.4 Measurement system

For performing HAC measurements the Schmid & Partner DASY4 dosimetric assessment system is used which is described below. Instead of dosimetric probes E-field and H-field probes for measurement in air are in use together with a HAC test arch.



The DASY4 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronic (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- A unit to operate the optical surface detector which is connected to the EOC.
- The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY4 measurement server.
- The DASY4 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows 2000
- DASY4 software and SEMCAD data evaluation software.
- Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.
- The generic twin phantom enabling the testing of left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- System validation dipoles allowing to validate the proper functioning of the system.

2.4.1 Test environment

CETECOM's second DASY4 measurement system, which is used both for SAR and HAC measurements, is placed in a room with dimensions :
3.6 x 3.4 x 3 m³, the SAM phantoms are placed in a distance of 65 cm from the rear wall and 1.0m from the side walls. Above the test system 1.5 x 1.5 m² arrays of pyramid absorbers are installed to reduce reflections from the ceiling.
Additional absorbers are placed around the HAC test set-up to prevent reflections from the robot arm.
Picture 1 of the photo documentation shows a complete view of the the test environment.
The system allows the measurement of E-field values larger than 2 V/m and H-field values larger than 10mA/m.

2.4.2 Probe description

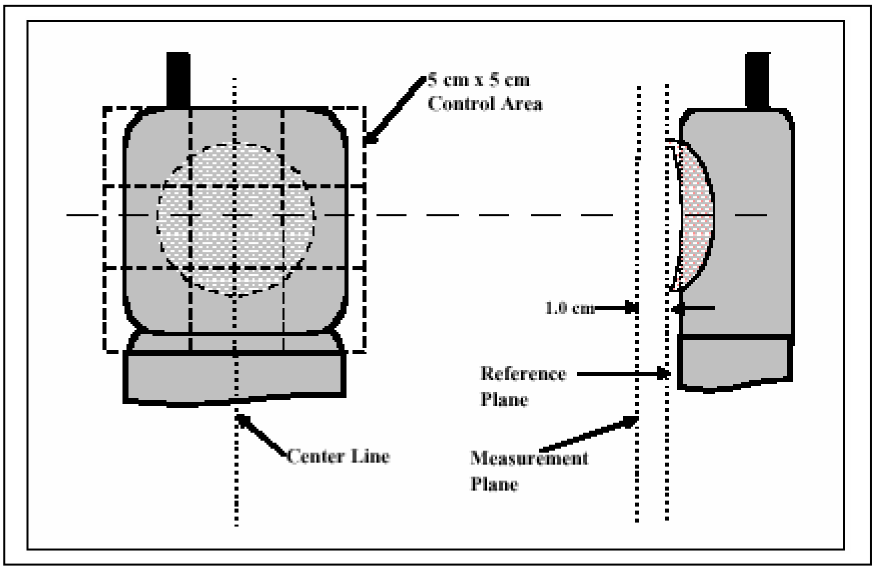
E-Field Probe ER3DV6 **(Technical data according to manufacturer information)**	
Construction	One dipole parallel and two dipoles normal to probe axis Built-in shielding against static charges
Calibration	In air from 100 MHz to 3 GHz (absolute accuracy ± 6.0%; k=2)
Frequency	100 MHz to >6 GHz; Linearity: ± 0.2 dB (100z to 3 GHz)
Directivity	± 0.2 dB in air (rotation around probe axis) ± 0.4 dB in air (rotation normal to probe axis)
Dynamic range	2 V/m to > 1000 V/m (M3/M4 device readings fall well below diode compression point)
Dimensions	Overall length: 330 mm; Tip length: 16 mm Body diameter: 12 mm; Tip diameter: 8 mm Distance from probe tip to dipole centers: 2.5mm

H-Field Probe H3DV6 **(Technical data according to manufacturer information)**	
Construction	Three concentric loop sensors with 3.8 mm loop diameters. Resistively loaded detector diodes for linear response Built-in shielding against static charges
Calibration	In air from 100 MHz to 3 GHz (absolute accuracy ± 6.0%; k=2)
Frequency	200 MHz to 3 GHz; Linearity: ± 0.2 dB (100z to 3 GHz)
Directivity	± 0.25 dB (spherical isotropy error)
Dynamic range	10 mA/m to 2 A/m at 1 GHz (M3/M4 device readings fall well below diode compression point)
Dimensions	Overall length: 330 mm; Tip length: 40 mm Body diameter: 12 mm; Tip diameter: 6 mm Distance from probe tip to dipole centers: 3 mm
E-Field Interference	< 10% at 3 GHz (for plane wave)

2.4.3 HAC test arch description

The HAC test arch is especially designed for performing measurements according to the requirements of ANSI C63.19. It allows centering the wireless device inside a 5 x 5 cm control area marked with 4 points for position adjustment. Plastic bridges allow an exact adjustment of the measurement distance to 1 cm from the DUT, which also includes the distance of the dipole center to the probe tip.
For centering the mobile phone speaker inside the control area and for adjusting the validation dipole position the test arch contains a nylon thread for alignment. (see picture)

The HAC test arch is placed on the cover of the DASY4 SAM phantom.



2.4.4 Device holder description

The DASY4 device holder (see picture above) has three scales for device inclination, height and side adjustment. The device holder position is adjusted to the standard measurement position e.g. center of the DUT speaker to the center of the 5 x 5 cm² control area with the device touching the plastic bridge of the HAC test arch. This device holder is used for standard mobile phones or PDA’s only. If necessary an additional support of polystyrene material is used.

2.4.5 Scanning procedure

The DASY4 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All tests are performed with the same configuration of test steps an in accordance with the requirements described in C63.19-2005 Chapter 4.3.1.2.2.

1. The HAC test setup is placed at the pre-defined position on top of the SAR phantom cover.
2. A phantom adjustment and verification is performed, which allows checking the borders and center position of the 5 x 5 cm² control area. The probe tip touches down on the 4 points at the corners of the control area
3. The wireless device (WD) is oriented in its intended test position (see photo documentation) with the reference plane in the horizontal plane and secured by the device holder. The acoustical output is placed in the center of the control area (predefined by the HAC test arch)
4. The DUT is set to transmit at maximum output power at the desired test channel(s).
5. „Reference“ and „drift“ measurements are located at the beginning and the end of the test batch process. They measure the field drift at one single point above the DUT over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. +/- 5 % (+/- 0.2 dB).
6. The „area scan“ measures the electrical or magnetic field strenth above the WD on a parallel plane to the surroundings of the control area at the upper end of the HAC test arch. It is used to locate the approximate location of the peak field strength with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical or magnetic field strenth is measured by the probe. The probe is moving at a distance of 1 cm to a defined plane above the WD during acquisition of measurement values. Standard grid spacing is 5 mm in x- and y- dimension. If a finer resolution is needed, the grid spacing can be reduced. Results of this scan are shown in annex 2.
7. At the maximum interpolated position a 360° rotation of the probe around the azimuth is performed. The maximum and delta reading from this rotation is used in re-evaluating the HAC category.
8. The automatic data evaluation performed by the software in respect of the requirements of the test standard subdivides the tested area of 5 x 5 cm into 9 squares. Within each square the maximum electrical or magnetic field strength is detected. For classification of M categories the 3 squares with highest field values may be excluded. Among the remaining 6, one of which is the center square, at least 4 squares with highest values both in E-field and in H-field scan must be evaluated. The results are automatically exported by the SEMCAD evaluation software together with the measurement plots. (See annex 2).

   The SEMCAD software also respects the articulation weighing factor (AWF), and converts the measured values to peak V/m or peak A/m using the probe modulation factor, which is determined by system validation measurements (see chapter …)

2.4.6 Data Storage and Evaluation

Data Storage

The DASY4 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation by SEMCAD

The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	Dcpi
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY4 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot cf/dcp_i$$

with	V_i	= compensated signal of channel i	(i = x, y, z)
	U_i	= input signal of channel i	(i = x, y, z)
	cf	= crest factor of exciting field	(DASY parameter)
	dcp_i	= diode compression point	(DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes: $$E_i = (V_i / Norm_i \cdot ConvF)^{1/2}$$

H-field probes: $$H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1}f + a_{i2}f^2)/f$$

with	V_i	= compensated signal of channel i	(i = x, y, z)
	$Norm_i$	= sensor sensitivity of channel i [mV/(V/m)^2] for E-field Probes	(i = x, y, z)
	ConvF	= sensitivity enhancement in solution	
	a_{ij}	= sensor sensitivity factors for H-field probes	
	f	= carrier frequency [GHz]	
	E_i	= electric field strength of channel i in V/m	
	H_i	= magnetic field strength of channel i in A/m	

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = (E_x^2 + E_Y^2 + E_z^2)^{1/2}$$

with	P_{pwe}	= equivalent power density of a plane wave in mW/cm^2
	E_{tot}	= total electric field strength in V/m
	H_{tot}	= total magnetic field strength in A/m

2.4.7 Test equipment utilized

This table gives a complete overview of the SAR measurement equipment

Devices used during the test described in chapter 2.5. are marked ☒

	Manufacturer	Device	Type	Serial number	Date of last calibration
☒	Schmid & Partner Engineering AG	E-Field Probe	ER3DV6	2262	January 7, 2005
☒	Schmid & Partner Engineering AG	H-Field Probe	H3DV6	6086	January 7, 2005
☐	Schmid & Partner Engineering AG	835 MHz System Validation Dipole	D900V2	1027	April 27, 2005
☒	Schmid & Partner Engineering AG	1880 MHz System Validation Dipole	CD1880V3	1021	April 28, 2005
☐	Schmid & Partner Engineering AG	2450 MHz System Validation Dipole	CD2450V3	1023	April 29, 2005
☒	Schmid & Partner Engineering AG	Data acquisition electronics	DAE3V1	477	May 20, 2005
☒	Schmid & Partner Engineering AG	Software	DASY4 V4.6	---	N/A
☒	Schmid & Partner Engineering AG	HAC test arch	SD HAC P01 BA	1022	N/A
☒	Rohde & Schwarz	Universal Radio Communication Tester	CMU 200	103992	November 15, 2004
☒	Nucletudes	Amplifier	M20.40.30	35/2001	N/A
☒	Agilent	Power Meter	438A	2804U01006	February 1, 2005
☒	Agilent	Power Meter Sensor	8482A	2703A03025	February 1, 2005
☒	Rohde & Schwarz	Power Meter	URV5	831392/004	June 14, 2005
☒	Rohde & Schwarz	Power Meter Sensor	URV5-Z2	839080/005	May 7, 2005
☒	Rohde & Schwarz	Spectrum Analyzer	FSIQ 26	8351111/004	April 7, 2005

2.4.8 Measurement uncertainty evaluation for HAC measurements

This measurement uncertainty budget is suggested by ANSI-C63.19 and determined by Schmid & Partner Engineering AG. It is valid for the frequency range 800 MHz – 3 GHz and represents a worst case analysis. The breakdown of the individual uncertainties is as follows:

Error Sources	Uncertainty Value	Probability Distribution	Divi-sor	c_i E	c_i H	Standard Uncertainty E	Standard Uncertainty H
Measurement System							
Probe calibration	± 5.1%	Normal	1	1	1	± 5.1%	± 5.1%
Axial isotropy)*	± 4.7%	Rectangular	√3	1	1	± 2.7%	± 2.7%
Sensor displacement	±16.5%	Rectangular	√3	1	0.145	± 9.5%	± 1.4%
Boundary effects	± 2.4%	Rectangular	√3	1	1	± 1.4%	± 1.4%
Probe linearity	± 4.7%	Rectangular	√3	1	1	± 2.7%	± 2.7%
Scaling to peak envelope power	± 2.0%	Rectangular	√3	1	1	± 1.2%	± 1.2%
System detection limits	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%
Readout electronics	± 0.3%	Normal	1	1	1	± 0.3%	± 0.3%
Response time	± 0.8%	Rectangular	√3	1	1	± 0.5%	± 0.5%
Integration time	± 2.6%	Rectangular	√3	1	1	± 1.5%	± 1.5%
RF ambient conditions)*	± 3.0%	Rectangular	√3	1	1	± 1.7%	± 1.7%
RF reflections)*	± 7.5%	Rectangular	√3	1	1	± 4.3%	± 4.3%
Probe positioner	± 1.2%	Rectangular	√3	1	0.67	± 0.7%	± 0.5%
Probe positioning	± 4.7%	Rectangular	√3	1	0.67	± 2.7%	± 1.8%
Extrapolation and Interpolation	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%
Test Sample Related							
Device positioning vertical	± 4.7%	Rectangular	√3	1	0.67	± 2.7%	± 1.8%
Device positioning lateral	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%
Device holder and Phantom	± 2.4%	Rectangular	√3	1	1	± 1.4%	± 1.4%
Power drift	± 5.0%	Rectangular	√3	1	1	± 2.9%	± 2.9%
Combined Uncertainty						**± 13.6%**	**± 9.4%**
Expanded Std. Uncertainty on Power						**± 27.2%**	**± 18.8%**
Expanded Std. Uncertainty on Field						**± 13.6%**	**± 9.4%**

)* : site specific

Table 1: Measurement uncertainties

2.4.9 Measurement uncertainty evaluation for system validation

This measurement uncertainty budget is suggested by ANSI-C63.19 and determined by Schmid & Partner Engineering AG. It is valid for the frequency range 800 MHz – 3 GHz and represents a worst case analysis. The breakdown of the individual uncertainties is as follows:

Error Sources	Uncertainty Value	Probability Distribution	Divi-sor	c_i E	c_i H	Standard Uncertainty E	Standard Uncertainty H
Measurement System							
Probe calibration	± 5.1%	Normal	1	1	1	± 5.1%	± 5.1%
Axial isotropy)*	± 4.7%	Rectangular	√3	1	1	± 2.7%	± 2.7%
Sensor displacement	±16.5%	Rectangular	√3	1	0.145	± 9.5%	± 1.4%
Boundary effects	± 2.4%	Rectangular	√3	1	1	± 1.4%	± 1.4%
Probe linearity	± 4.7%	Rectangular	√3	1	1	± 2.7%	± 2.7%
Scaling to peak envelope power	± 0.0%	Rectangular	√3	1	1	± 0.0%	± 0.0%
System detection limits	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%
Readout electronics	± 0.3%	Normal	1	1	1	± 0.3%	± 0.3%
Response time	± 0.0%	Rectangular	√3	1	1	± 0.0%	± 0.0%
Integration time	± 0.0%	Rectangular	√3	1	1	± 0.0%	± 0.0%
RF ambient conditions)*	± 3.0%	Rectangular	√3	1	1	± 1.7%	± 1.7%
RF reflections)*	± 3.8%	Rectangular	√3	1	1	± 2.2%	± 2.2%
Probe positioner	± 1.2%	Rectangular	√3	1	0.67	± 0.7%	± 0.5%
Probe positioning	± 4.7%	Rectangular	√3	1	0.67	± 2.7%	± 1.8%
Extrapolation and Interpolation	± 1.0%	Rectangular	√3	1	1	± 0.6%	± 0.6%
Dipole Related							
Distance dipole – scanning plane	± 5.2%	Rectangular	√3	1	0.3	± 3.0%	± 0.9%
Input power	± 4.7%	Normal	1	1	1	± 4.7%	± 4.7%
Combined Uncertainty						**± 13.4%**	**± 8.9%**
Expanded Std. Uncertainty on Power						**± 26.9%**	**± 17.8%**
Expanded Std. Uncertainty on Field						**± 13.4%**	**± 8.9%**

)* : site specific

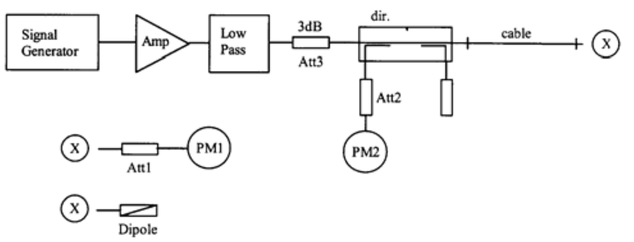
Table 2: Measurement uncertainties

2.4.10 System validation

The system validation is performed for verifying the accuracy of the complete measurement system and performance of the software. The following chapters contain validation descriptions as well as results for all frequency bands and both for E- and H-field probes.
(additional graphic plot(s) see annex 1).

2.4.11 Validation procedure

According to the requirements of ANSI C63.19 chapter 4.2.2.1.1 the validation is performed by using a validation dipole which is positioned parallel to the nylon fibre of the HAC test arch. The dipole is connected to the the signal source consisting of signal generator and amplifier via an directional coupler , N-connector cable and adaption to SMA. It is fed with a power of 100 mW (20 dBm). To adjust this power a power meter is used . The power sensor is connected to the cable before the validation to measure the power at this point and do adjustments at the signal generator. At the outputs of the directional coupler both return loss as well as forward power are controlled during the validation to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test (result on plot).
During the validation the measurement system scans a grid along the length of the dipole and the maximum value is recorded.
This validation is peformed periodically both with E and H field probes on the center frequencies of the frequency bands used by the wireless device.
Validation results have to be equal or near the values determined during dipole calibration (target SAR in table below) with the same test system set-up.



Freq. / MHz	Signal type	Peak Output Power / dBm)*	Target Field Strenth (+/- 10%)	Measured Field Strength	Deviation (%)
1880	CW	20	136.7 V/m	137.6 V/m	0.6
1880	CW	20	0.452 A/m	0.467 A/m	3.3

Table 3: Results system validation

)* Note : calibration by test system manufacturer has been performed with 20 dBm CW input power fed to the validation dipole. Field strength values acquired with full rated power of wireless devices as performed in the following chapters (e.g. 25 , 30, 33 dBm) can’t be compared directly to the target values in the table above.

According to ANSI C63.19 Chapter 4.2.2.1.2.1 it is recommended to compare measurement results of 3 different test cases : CW, 80% AM and signal of the wireless device.

- The probe is moved to the position with the highest field strength found during system validation with CW.
- The wireless device (WD) or an emulated signal source (e.g. CMU 200) is set to apply full rated power into the reference dipole.
- Average and peak output power of the WD or emulated signal source are measured using a peak power meter.
- Average power emitted by the dipole is measured with the DASY4 system.
- The same procedure is repeated with a CW and an AM signal with 80% modulation index which have the same peak power as determined with the signal modulation format of the wireless device.

From the measured results the peak-to-average-ratio (PAR) is determined.

Estimation of expected values :

a) CW

Peak-to-Average-Ratio : 0.0 dB

b) 80% AM

Peak-to-Average Ratio (dB) = $10*\log(m+1)^2$ with modulation index m = 0.8

PAR_{log} = 5.1 dB
PAR_{lin} = 1.8

c) GSM

PAR_{log} = 9 dB
PAR_{lin} = 8 (for one of eight timeslots in use)

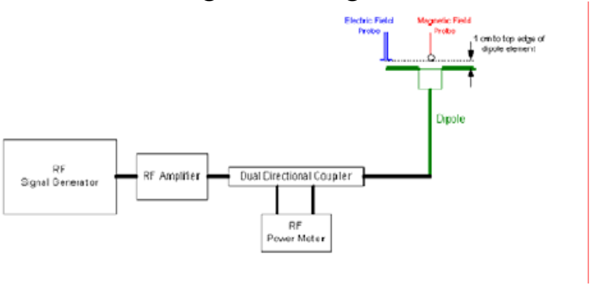
The linear PAR corresponds to the crest factor of the corresponding signal type.

2.4.12 Determination of probe modulation factor

The probe modulation factor indicates the relation between the measured RMS (average) field strength values and the peak field strength of a modulated signal, which will be used by the data evaluation software to calculate from measured RMS values to peak field values for HAC evaluation. It can be determined by comparing a CW signal with a modulated signal having the same peak envelope power as defined in ANSI C63.19 Annex C.3.1.

The following procedure according to the recommendations of DASY4 HAC application note chapter 28.6 has been used :

- The probe remains in the position with the highest field strength found during system validation.
- The probe is illuminated with a signal using the same modulation as the DUT (The WD itself or an emulated signal generated by the CMU 200) on the center of the WD's frequency band. The output power is adjusted to the standard peak envelope power of the WD's modulation system and measured with a spectrum analyzer in linear mode with 0 Hz span (ANSI recommendation) and/or a power meter being able to measure Peak envelope power (FCC recommendation).
- The field strength at this position is recorded using the multimeter function of the DASY4 software.
- Then a CW signal is adjusted to the same frequency and peak reading as the modulated signal measured with spectrum analyzer or power meter.
- This signal is fed to the validation dipole and the measured field strength is recorded.
- The ratio of the CW to the modulated signal reading is the modulation factor.



Modulation Factor = Measured E/H-Field (CW signal) / Measured E/H-Field (modulated signal)

For E-field probes the following formula is generally valid :

$(\text{Probe Modulation Factor})^2 = \text{Crest Factor}$

For GSM with 1 of 8 timeslots in use the PMF should be ≈ 2.82

For H-field probes the modulation factor differs with amplitude, frequency, modulation and probe.

Specific information about the determination of the probe modulation factor (manufacturer application note) is attached to the calibration document delivered together with this test report.

2.4.13 Measured PAR and PMF

Freq. / MHz	Signal type	Average Output Power / dBm)*	Peak Output Power / dBm)*	Peak-to Average Ratio / dB	Measured Field Strength with DASY4 System	Probe Modulation Factor
1880	CW	30	30	0.0	439.4 V/m	----
1880	80% AM	24.9	30	5.1	256.2 V/m	1.72
1880	GSM	20.9	30	9.1	155.3 V/m	**2.83**
1880	CW	30	30	0.0	1.389 A/m	----
1880	80% AM	24.9	30	5.1	0.914 A/m	1.52
1880	GSM	20.9	30	9.1	0.644 A/m	**2.16**

Table 4: Results of PAR and PMF determination

)* Peak and average output power levels were measured using the Rhode & Schwarz URV5 Power Meter.

Important note :

According to manufacturer information diode based probes are inherently non-symmetric and tend to peak detection for modulated signals. SPEAG's E-field probes are designed such they are largely symmetric and accurate RMS can be obtained from pulsed signals applying the correct crest factor. The same feature could not be applied for the H-field probes such that the RMS value cannot be detected for signals other than CW without additional calibration.
So probe modulation factors of H-field probes differ more or less from those determined for E-field probes or expected target values.
In DASY V4.6 the crest factor and probe modulation factor handling has been separated.
For HAC evaluation with SPEAG's SEMCAD software the above listed probe modulation factors need to be entered additionally, so that time averaged values are automatically calculated to slotted peak field strength values.
The crest factor setting is still necessary as it is used to perform the compensation of the diode compression on the peak power. (DASY4 user manual chapter 4.4.2).

General settings for crest factor are :

CW : 1
AM 80% : 1.8
GSM : 8

They are applied both during validation procedures, PMF determination and measurements of the DUT.

2.5 Test results

Hearing Aid Compatibility results for E-Field					
Channel / frequency	test condition	Max. E-field (peak)	M3 Limit	Category	Air temperature
512 / 1850.2 MHz	normal	55.9 V/m	84.1 V/m	M3	23.1 °C
661 / 1880.0 MHz	normal	64.8 V/m	84.1 V/m	M3	23.1 °C
810 / 1909.8 MHz	normal	67.4 V/m	84.1 V/m	M3	23.1 °C
810 / 1909.8 MHz	worst case	69.0 V/m	84.1 V/m	M3	23.1 °C

Table 5: Test results (E-Field)

Hearing Aid Compatibility results for H-Field					
Channel / frequency	test conditon	Max. H-field (peak)	M3 Limit	Category	Air temperature
512 / 1850.2 MHz	normal	0.154 A/m	0.25 A/m	M3	23.2 °C
661 / 1880.0 MHz	normal	0.181 A/m	0.25 A/m	M3	23.2 °C
810 / 1909.8 MHz	normal	0.201 A/m	0.25 A/m	M3	23.2 °C
810 / 1909.8 MHz	worst case	0.209 A/m	0.25 A/m	M3	23.2 °C

Table 6: Test results (H-Field)

The above given test results represent the worst case condition without the use of exclusion blocks. Exluding blocks does not improve HAC category.

Overall category : M3

2.5.1 Description of test procedures

The device was tested using a CMU 200 communications tester as controller unit to set test channels and maximum output power to the DUT, as well as for measuring the conducted peak power. The conducted output power was measured using a integrated RF connector and attached RF cable.
Worst case configuration evaluation was performed by rotating the probe 360° at azimuth axis to respect probe isotropy error and calculation to maximum peak (see annex 2).

2.6 Test results (conducted power measurement)

For the measurements a Rohde & Schwarz Radio Communication Tester CMU 200 was used.
The output power was measured using a integrated RF connector and attached RF cable.
The conducted output power was measured before and after each SAR measurement. The resulting power values were within a 0.2 dB tolerance of the values shown below.

PCS 1900	
Channel	peak power
512	29.7 dBm
661	29.4 dBm
810	29.0 dBm

Table 7: Test results conducted peak power measurement

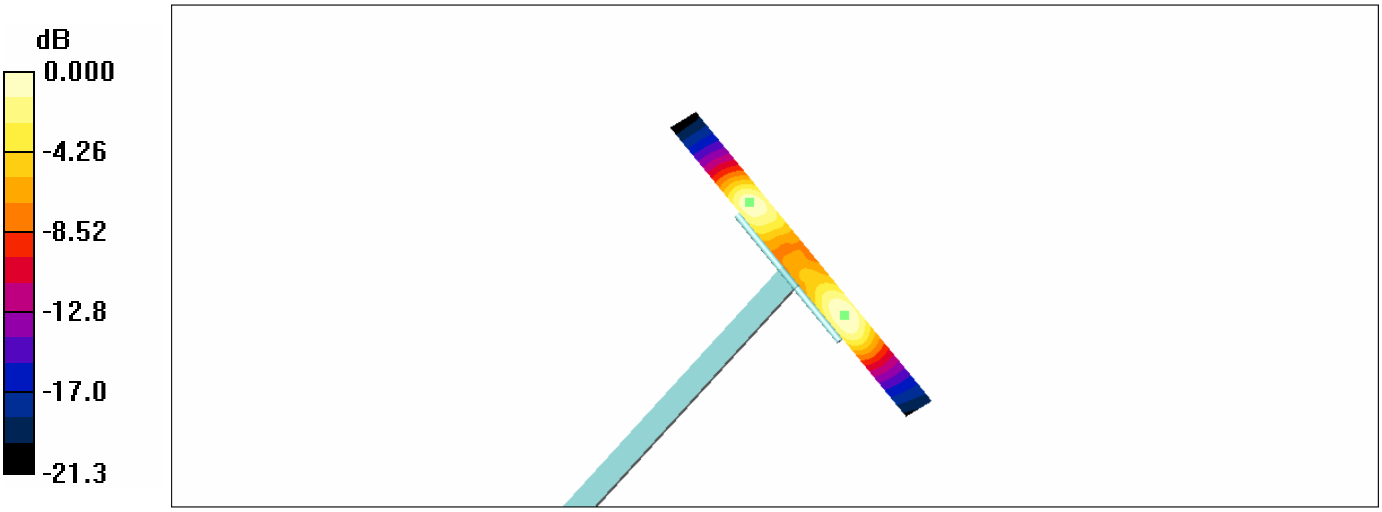
Annex 1 System performance verification

Date/Time: 26.09.2005 15:14:38

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1021
Program Name: HAC E Dipole
Communication System: CW; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Dipole Section
DASY4 Configuration:
- Probe: ER3DV6 - SN2262; ConvF(1, 1, 1); Calibrated: 07.01.2005
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn477; Calibrated: 20.05.2005
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1022
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 159

E Scan 10mm above CD 1880 MHz CW/Hearing Aid Compatibility Test (41x361x1):

Measurement grid: dx=5mm, dy=5mm
Probe Modulation Factor = 1.00
Reference Value = 67.9 V/m; Power Drift = 0.019 dB
Maximum value of Total (interpolated) = 137.6 V/m



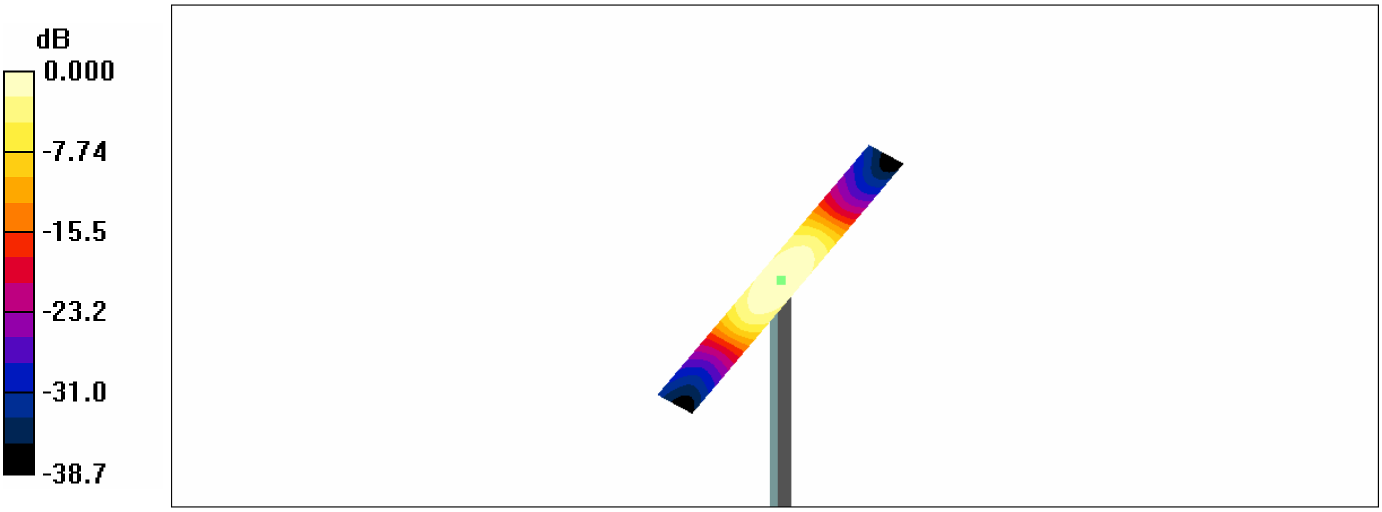
0 dB = 137.6V/m

Date/Time: 26.09.2005 14:12:38

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1021
Program Name: HAC H Dipole
Communication System: CW; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: H Dipole Section
DASY4 Configuration:
- Probe: H3DV6 - SN6086; ; Calibrated: 07.01.2005
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn477; Calibrated: 20.05.2005
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1022
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 159

H Scan 10mm above CD 1880 MHz CW/Hearing Aid Compatibility Test (41x361x1):

Measurement grid: dx=5mm, dy=5mm
Probe Modulation Factor = 1.00
Reference Value = 0.468 A/m; Power Drift = -0.065 dB
Maximum value of Total (interpolated) = 0.467 A/m



0 dB = 0.467A/m

Annex 2 Measurement results (printout from DASY ™)

Remark : results of conducted power measurements: see chapter 2.5/2.6 (if applicable)
Top edge of mobile is on the right hand side of the plots

Date/Time: 26.09.2005 15:33:32

DUT: Siemens; Type: CF62T; Serial: 00-4999-00-309725-9
Program Name: HAC E Device
Communication System: PCS 1900; Frequency: 1850.2 MHz;Duty Cycle: 1:8
Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: E Device Section
DASY4 Configuration:
- Probe: ER3DV6 - SN2262; ConvF(1, 1, 1); Calibrated: 07.01.2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn477; Calibrated: 20.05.2005
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1022
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 159

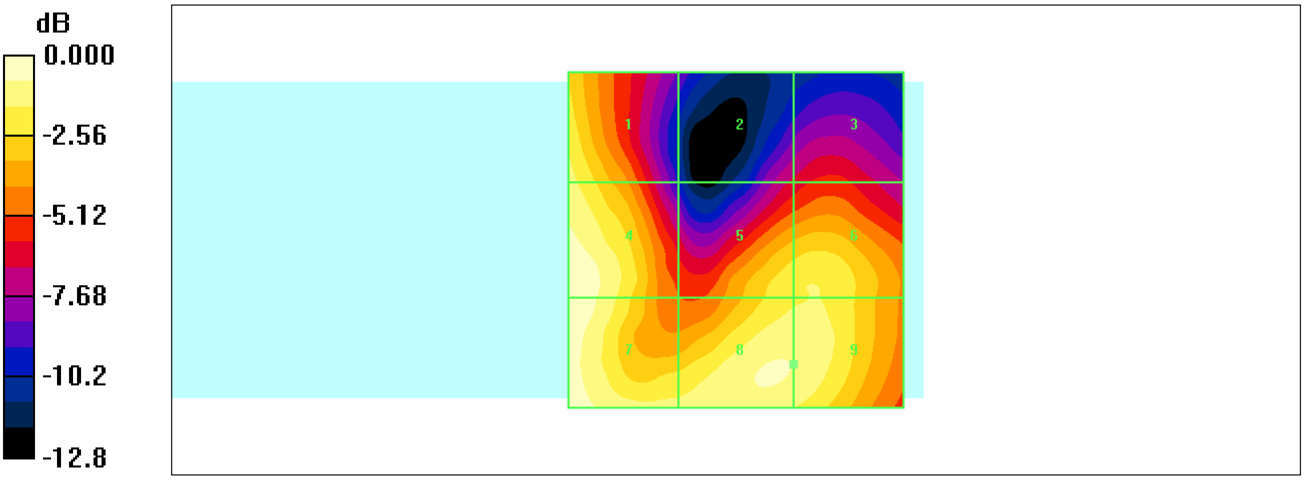
E Scan 10mm above Device Reference/Hearing Aid Compatibility Test (101x101x1):

Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 55.9 V/m
Probe Modulation Factor = 2.83
Reference Value = 9.78 V/m; Power Drift = -0.010 dB
Hearing Aid Near-Field Category: M3 (AWF -5 dB)

Peak E-field in V/m

Grid 1 **48.1**	Grid 2 **26.4**	Grid 3 **29.3**
Grid 4 **54.8**	Grid 5 **45.3**	Grid 6 **46.1**
Grid 7 **55.9**	Grid 8 **51.2**	Grid 9 **50.6**

Category	AWF (dB)	Limits for E-Field Emissions (V/m)	Limits for H-Field Emissions (A/m)
M1	0	199.5 - 354.8	0.6 - 1.07
	-5	149.6 - 266.1	0.45 - 0.8
M2	0	112.2 - 199.5	0.34 - 0.6
	-5	84.1 - 149.6	0.25 - 0.45
M3	0	63.1 - 112.2	0.19 - 0.34
	-5	47.3 - 84.1	0.15 - 0.25
M4	0	<63.1	<0.19
	-5	<47.3	<0.15



0 dB = 55.9V/m

Date/Time: 26.09.2005 15:26:25

DUT: Siemens; Type: CF62T; Serial: 00-4999-00-309725-9
Program Name: HAC E Device
Communication System: PCS 1900; Frequency: 1880 MHz;Duty Cycle: 1:8
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Device Section
DASY4 Configuration:
- Probe: ER3DV6 - SN2262; ConvF(1, 1, 1); Calibrated: 07.01.2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn477; Calibrated: 20.05.2005
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1022
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 159

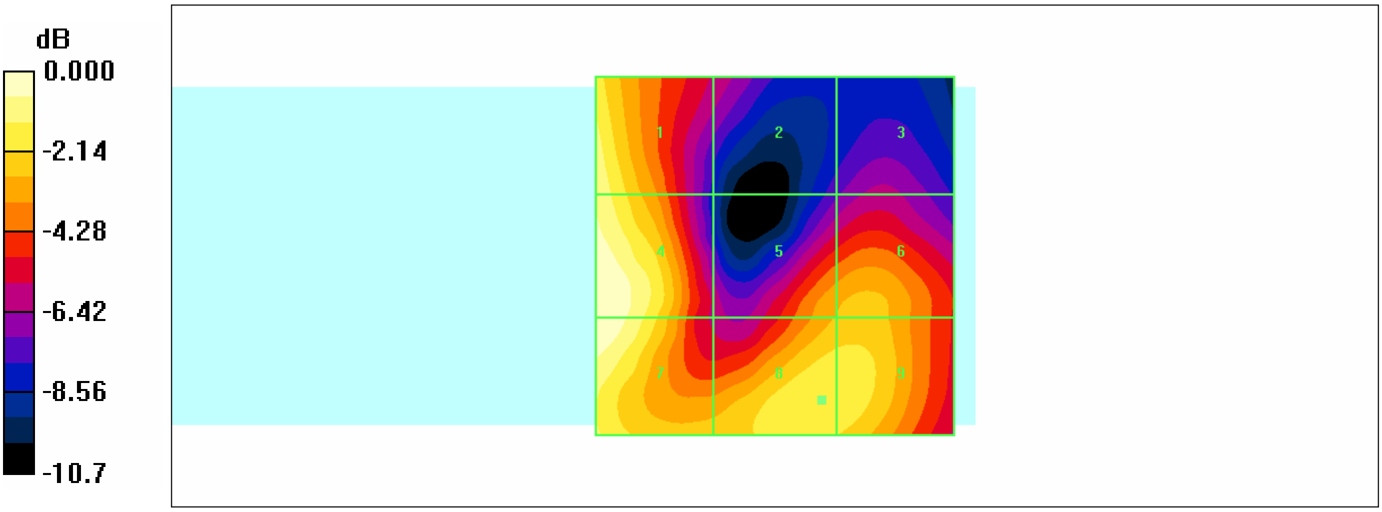
E Scan 10mm above Device Reference 2/Hearing Aid Compatibility Test (101x101x1):

Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 64.8 V/m
Probe Modulation Factor = 2.83
Reference Value = 9.19 V/m; Power Drift = -0.158 dB
Hearing Aid Near-Field Category: M3 (AWF -5 dB)

Peak E-field in V/m

Grid 1 **59.5**	Grid 2 **33.3**	Grid 3 **32.0**
Grid 4 **64.8**	Grid 5 **46.9**	Grid 6 **48.5**
Grid 7 **64.7**	Grid 8 **54.8**	Grid 9 **54.4**

Category	AWF (dB)	Limits for E-Field Emissions (V/m)	Limits for H-Field Emissions (A/m)
M1	0	199.5 - 354.8	0.6 - 1.07
	-5	149.6 - 266.1	0.45 - 0.8
M2	0	112.2 - 199.5	0.34 - 0.6
	-5	84.1 - 149.6	0.25 - 0.45
M3	0	63.1 - 112.2	0.19 - 0.34
	-5	47.3 - 84.1	0.15 - 0.25
M4	0	<63.1	<0.19
	-5	<47.3	<0.15



0 dB = 64.8V/m

Date/Time: 26.09.2005 15:42:04

DUT: Siemens; Type: CF62T; Serial: 00-4999-00-309725-9
Program Name: HAC E Device
Communication System: PCS 1900; Frequency: 1909.8 MHz;Duty Cycle: 1:8
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Device Section
DASY4 Configuration:
- Probe: ER3DV6 - SN2262; ConvF(1, 1, 1); Calibrated: 07.01.2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn477; Calibrated: 20.05.2005
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1022
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 159

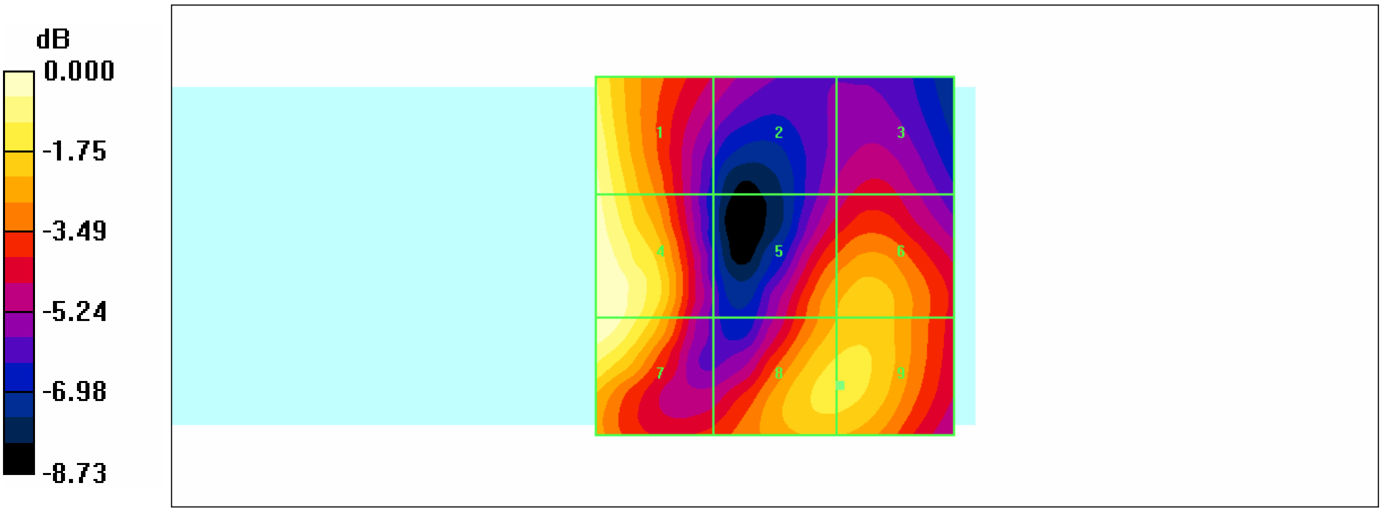
E Scan 10mm above Device Reference 3/Hearing Aid Compatibility Test (101x101x1):

Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 67.4 V/m
Probe Modulation Factor = 2.83
Reference Value = 10.7 V/m; Power Drift = 0.037 dB
Hearing Aid Near-Field Category: M3 (AWF -5 dB)

Peak E-field in V/m

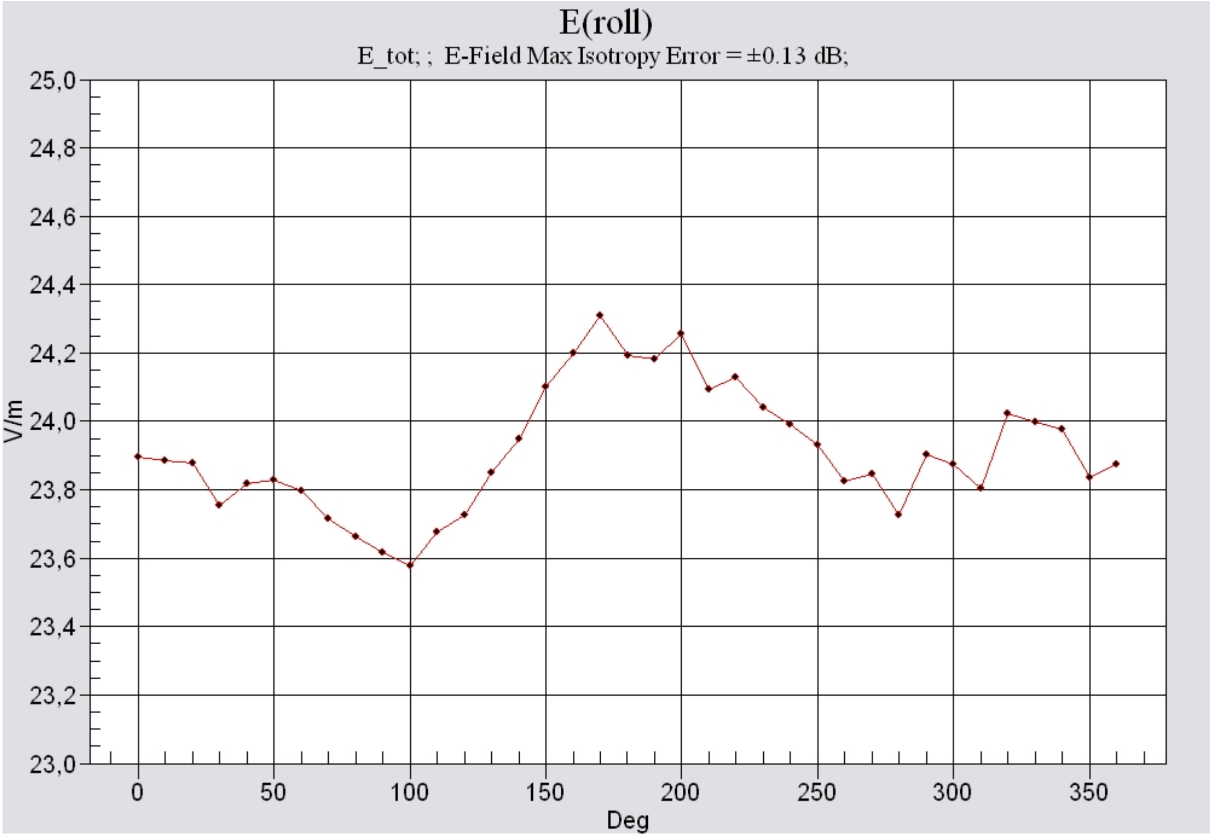
Grid 1 **64.6**	Grid 2 **39.3**	Grid 3 **40.9**
Grid 4 **67.4**	Grid 5 **51.5**	Grid 6 **53.9**
Grid 7 **66.9**	Grid 8 **56.7**	Grid 9 **56.7**

Category	AWF (dB)	Limits for E-Field Emissions (V/m)	Limits for H-Field Emissions (A/m)
M1	0	199.5 - 354.8	0.6 - 1.07
	-5	149.6 - 266.1	0.45 - 0.8
M2	0	112.2 - 199.5	0.34 - 0.6
	-5	84.1 - 149.6	0.25 - 0.45
M3	0	63.1 - 112.2	0.19 - 0.34
	-5	47.3 - 84.1	0.15 - 0.25
M4	0	<63.1	<0.19
	-5	<47.3	<0.15



0 dB = 67.4V/m

peak determination after probe rotation :



(24.3 – 23.9) / 23.9 = 1.67 %

peak value on worst case position : 1.0167 * 67.9 V/m = 69.0 V/m

Date/Time: 26.09.2005 14:39:50

DUT: Siemens; Type: CF62T; Serial: 00-4999-00-309725-9
Program Name: HAC H Device
Communication System: PCS 1900; Frequency: 1850.2 MHz;Duty Cycle: 1:8
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: H Device Section
DASY4 Configuration:
- Probe: H3DV6 - SN6086; ; Calibrated: 07.01.2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn477; Calibrated: 20.05.2005
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1022
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 159

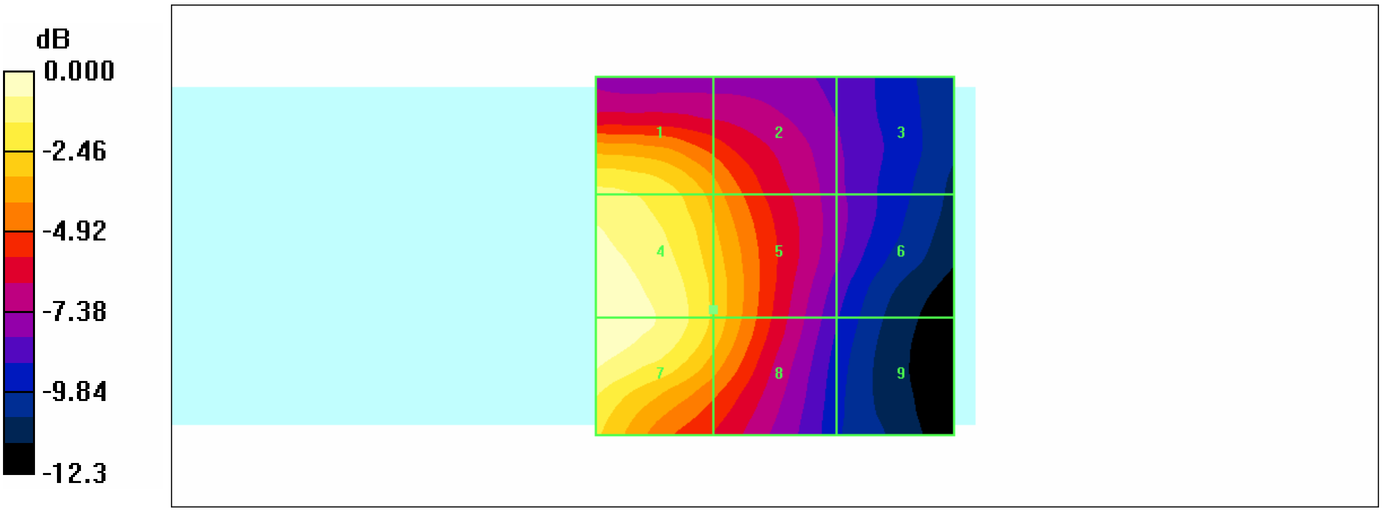
H Scan 10mm above Device Reference/Hearing Aid Compatibility Test (101x101x1):

Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.154 A/m
Probe Modulation Factor = 2.16
Reference Value = 0.038 A/m; Power Drift = -0.002 dB
Hearing Aid Near-Field Category: M3 (AWF -5 dB)

Peak H-field in A/m

Grid 1 **0.132**	Grid 2 **0.101**	Grid 3 **0.062**
Grid 4 **0.154**	Grid 5 **0.114**	Grid 6 **0.063**
Grid 7 **0.154**	Grid 8 **0.114**	Grid 9 **0.056**

Category	AWF (dB)	Limits for E-Field Emissions (V/m)	Limits for H-Field Emissions (A/m)
M1	0	199.5 - 354.8	0.6 - 1.07
	-5	149.6 - 266.1	0.45 - 0.8
M2	0	112.2 - 199.5	0.34 - 0.6
	-5	84.1 - 149.6	0.25 - 0.45
M3	0	63.1 - 112.2	0.19 - 0.34
	-5	47.3 - 84.1	0.15 - 0.25
M4	0	<63.1	<0.19
	-5	<47.3	<0.15



0 dB = 0.154A/m

Date/Time: 26.09.2005 14:47:15

DUT: Siemens; Type: CF62T; Serial: 00-4999-00-309725-9
Program Name: HAC H Device
Communication System: PCS 1900; Frequency: 1880 MHz;Duty Cycle: 1:8
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: H Device Section
DASY4 Configuration:
- Probe: H3DV6 - SN6086; ; Calibrated: 07.01.2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn477; Calibrated: 20.05.2005
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1022
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 159

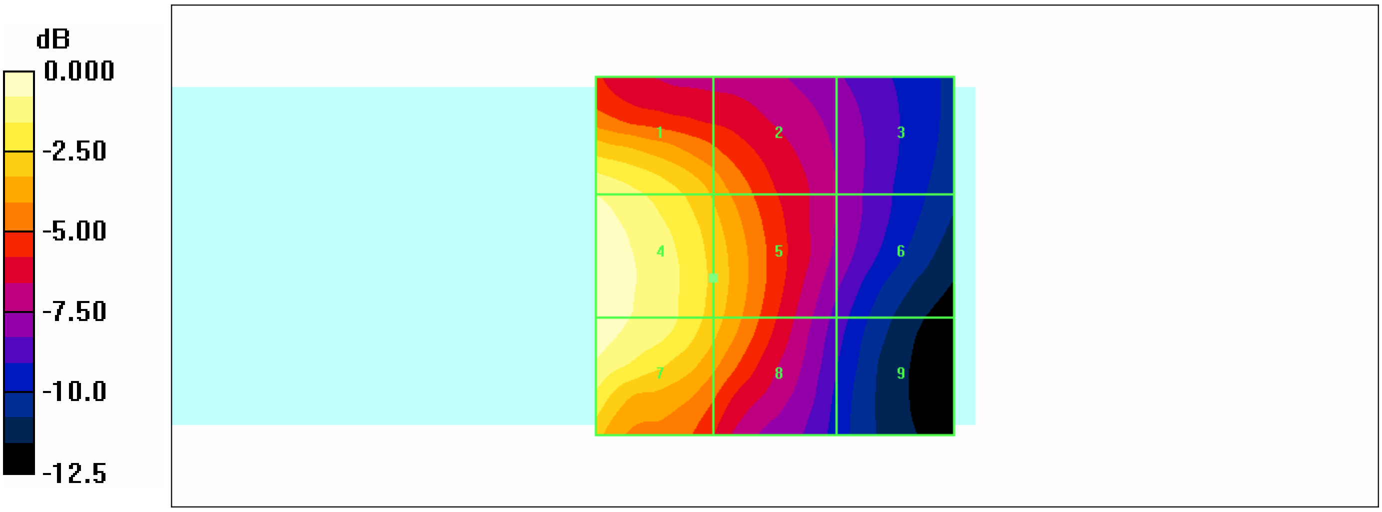
H Scan 10mm above Device Reference 2/Hearing Aid Compatibility Test (101x101x1):

Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.181 A/m
Probe Modulation Factor = 2.16
Reference Value = 0.046 A/m; Power Drift = -0.032 dB
Hearing Aid Near-Field Category: M3 (AWF -5 dB)

Peak H-field in A/m

Grid 1 **0.165**	Grid 2 **0.122**	Grid 3 **0.076**
Grid 4 **0.181**	Grid 5 **0.132**	Grid 6 **0.077**
Grid 7 **0.177**	Grid 8 **0.129**	Grid 9 **0.067**

Category	AWF (dB)	Limits for E-Field Emissions (V/m)	Limits for H-Field Emissions (A/m)
M1	0	199.5 - 354.8	0.6 - 1.07
	-5	149.6 - 266.1	0.45 - 0.8
M2	0	112.2 - 199.5	0.34 - 0.6
	-5	84.1 - 149.6	0.25 - 0.45
M3	0	63.1 - 112.2	0.19 - 0.34
	-5	47.3 - 84.1	0.15 - 0.25
M4	0	<63.1	<0.19
	-5	<47.3	<0.15



0 dB = 0.181A/m

Date/Time: 26.09.2005 14:52:23

DUT: Siemens; Type: CF62T; Serial: 00-4999-00-309725-9
Program Name: HAC H Device
Communication System: PCS 1900; Frequency: 1909.8 MHz;Duty Cycle: 1:8
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: H Device Section
DASY4 Configuration:
- Probe: H3DV6 - SN6086; ; Calibrated: 07.01.2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn477; Calibrated: 20.05.2005
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1022
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 159

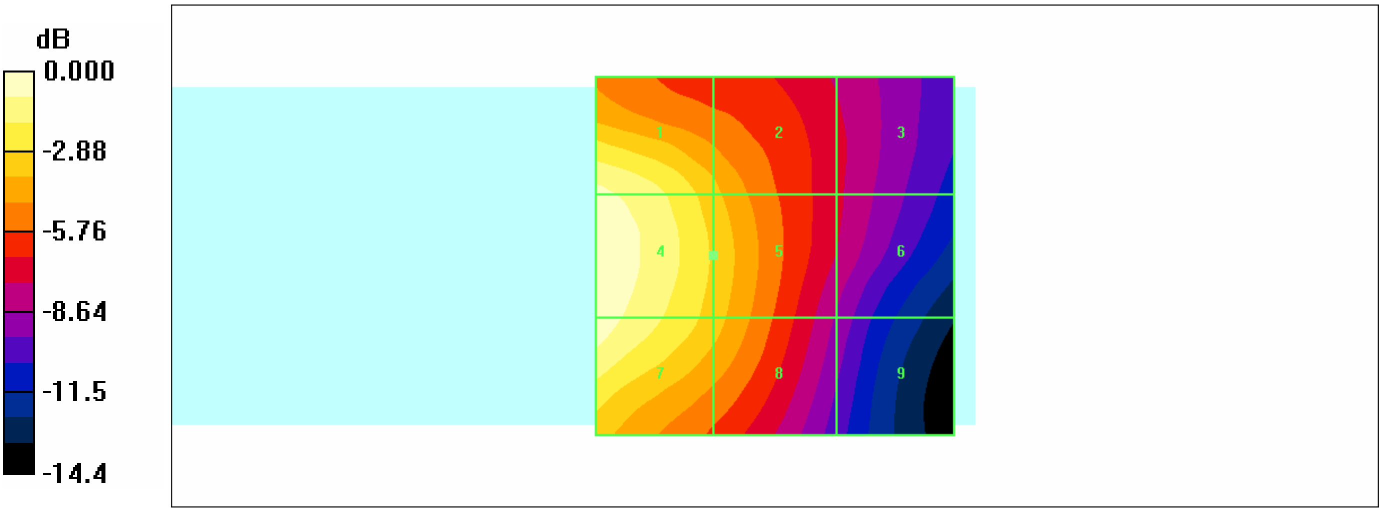
H Scan 10mm above Device Reference 3/Hearing Aid Compatibility Test (101x101x1):

Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.201 A/m
Probe Modulation Factor = 2.16
Reference Value = 0.050 A/m; Power Drift = -0.098 dB
Hearing Aid Near-Field Category: M3 (AWF -5 dB)

Peak H-field in A/m

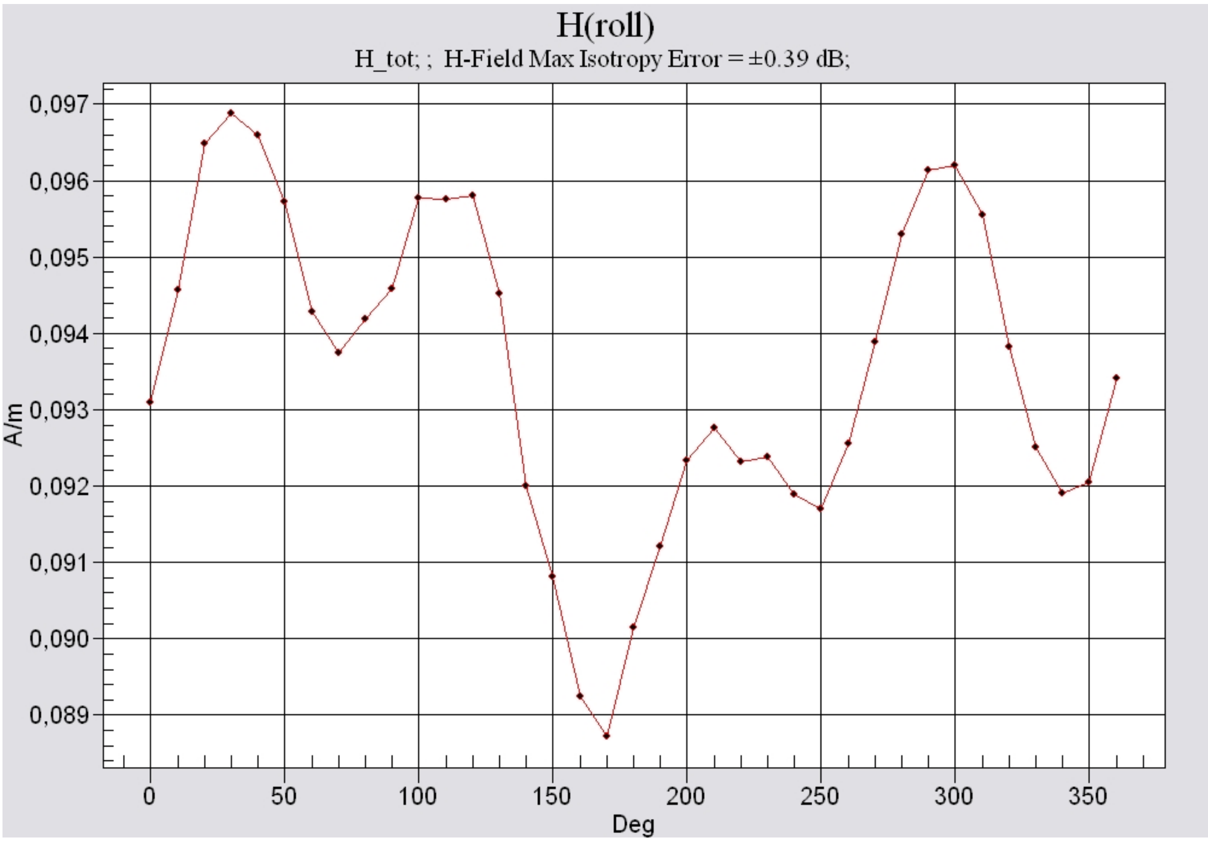
Grid 1 **0.187**	Grid 2 **0.134**	Grid 3 **0.086**
Grid 4 **0.201**	Grid 5 **0.142**	Grid 6 **0.086**
Grid 7 **0.194**	Grid 8 **0.136**	Grid 9 **0.074**

Category	AWF (dB)	Limits for E-Field Emissions (V/m)	Limits for H-Field Emissions (A/m)
M1	0	199.5 - 354.8	0.6 - 1.07
	-5	149.6 - 266.1	0.45 - 0.8
M2	0	112.2 - 199.5	0.34 - 0.6
	-5	84.1 - 149.6	0.25 - 0.45
M3	0	63.1 - 112.2	0.19 - 0.34
	-5	47.3 - 84.1	0.15 - 0.25
M4	0	<63.1	<0.19
	-5	<47.3	<0.15



0 dB = 0.201A/m

peak determination after probe rotation :



(0.0969 – 0.0931) / 0.0931 = 4.08 %

peak value on worst case position : 1.0408 * 0.201 A/m = <u>0.2092</u> A/m

Annex 3 Photo documentation

Picture no. 1

Measurement System DASY 4

Picture no. 2

DUT

Picture no. 3

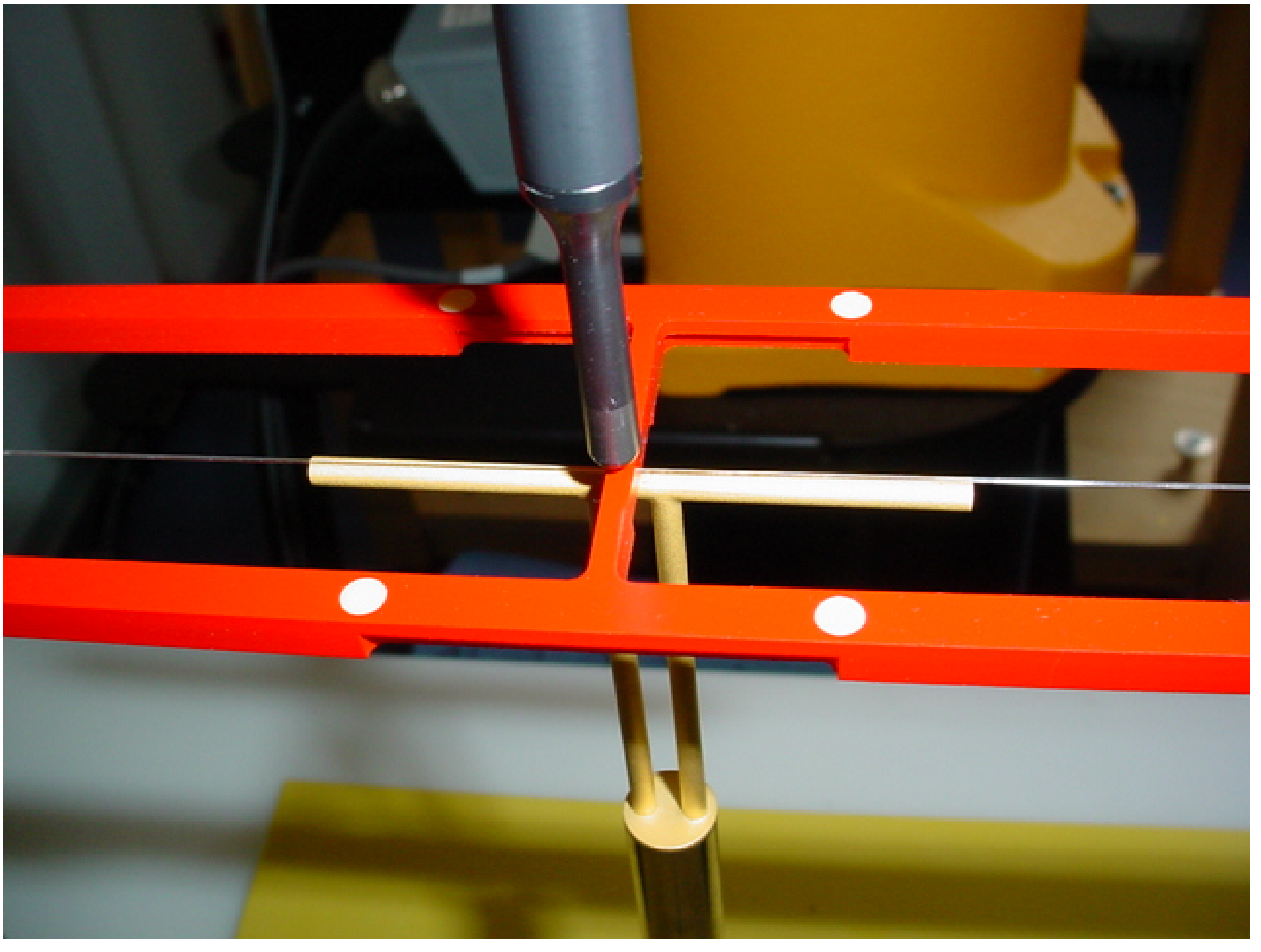
DUT with E-field overlay

Picture no. 4

DUT with H-field overlay

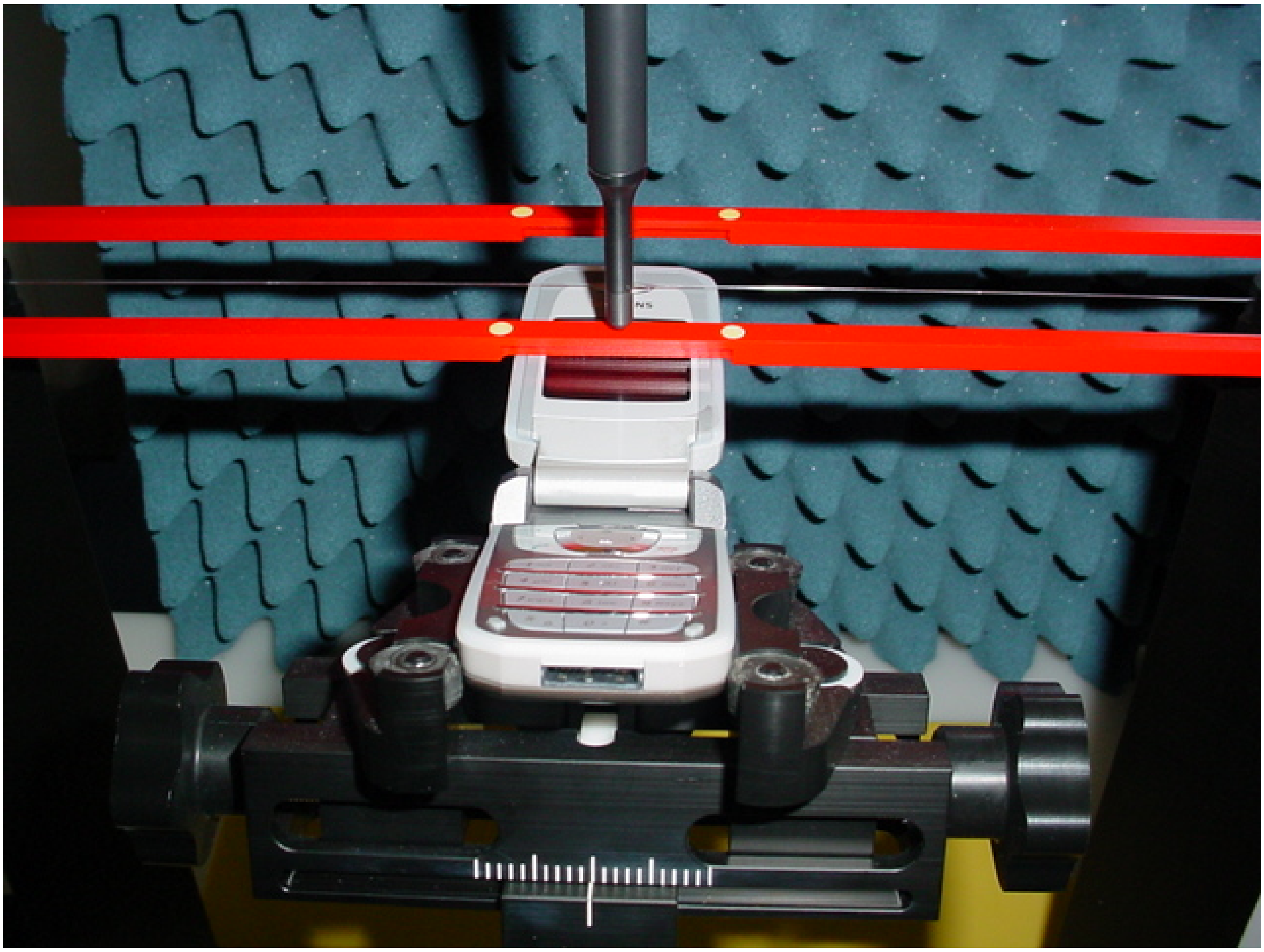
Picture no. 5

system validation



Picture no. 6

DUT at test position

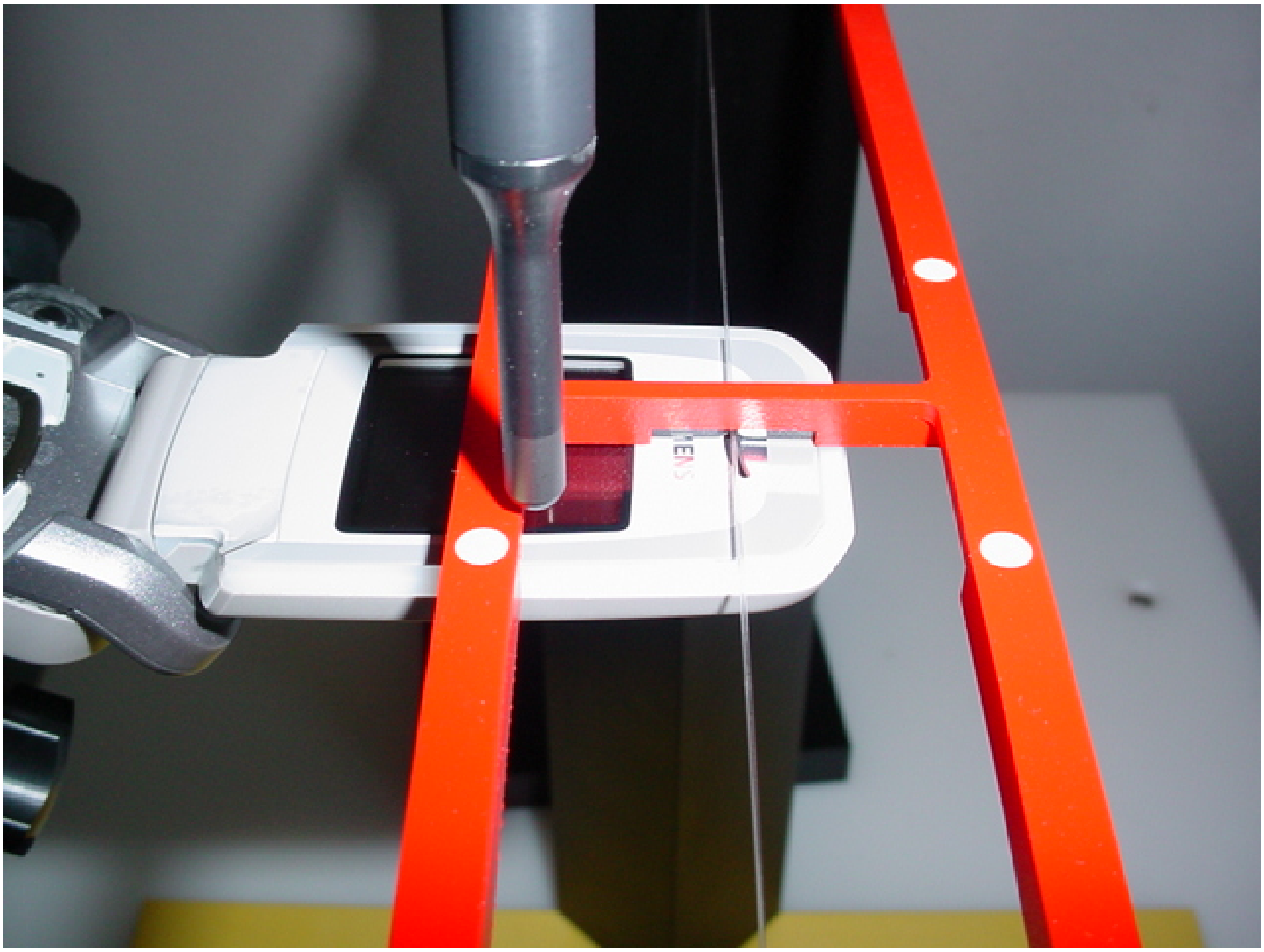


Picture no. 7

E-field measurement

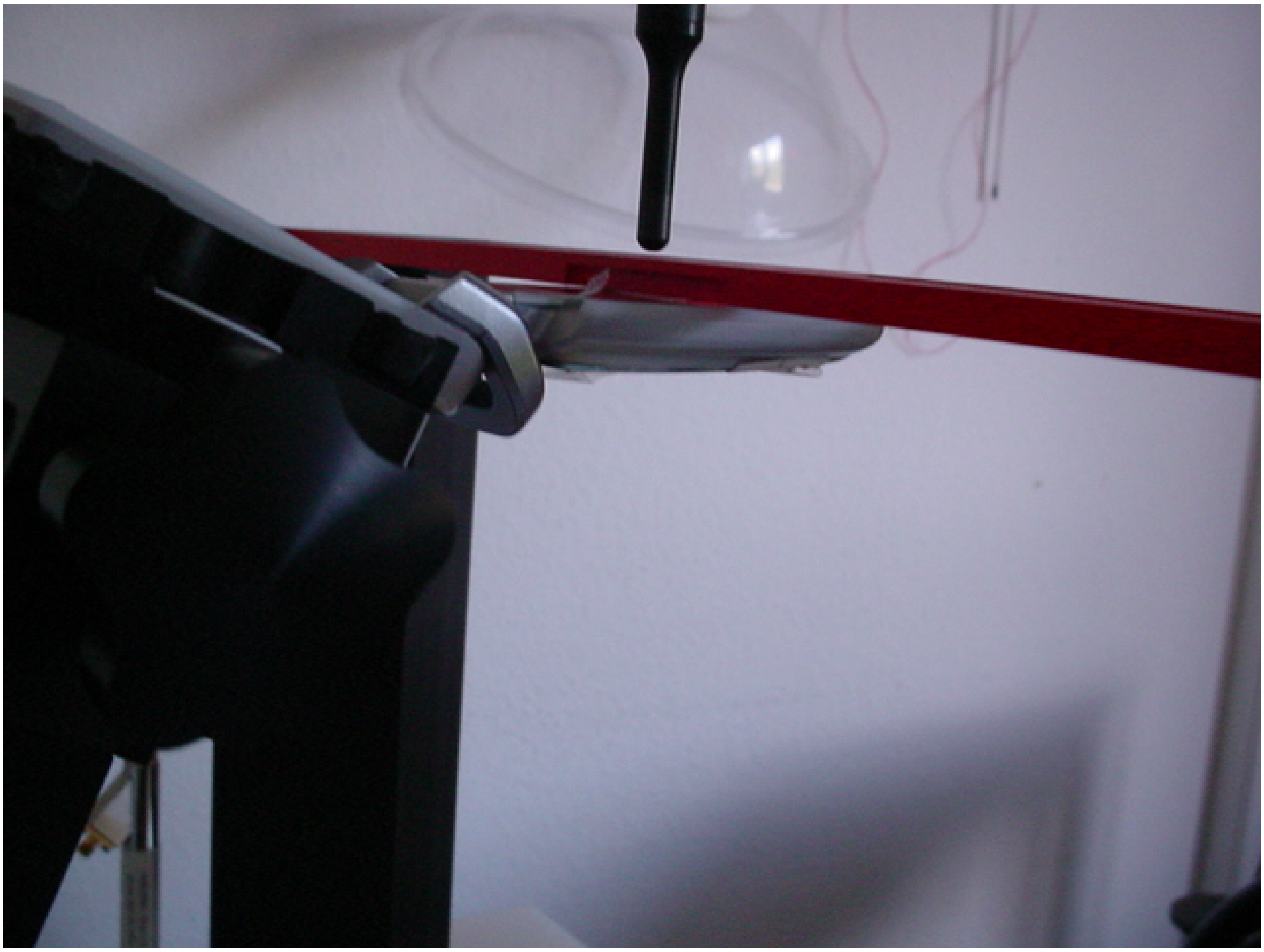
Picture no. 8

H-field measurement



Picture no. 9

H-field probe distance



Picture no. 10

E-field probe distance

Annex 4 Calibration parameters

Calibration parameters are described in the additional document :

Appendix to test report report no. 4-1832-01-01/05‘
Calibration data and system validation information