Hearing Aid Compatibility (HAC) RF Emissions Test Report

for

Palm, Inc.

on the

Smart Phone

Report Number	**:**	**HA891114A**
Brand Name	**:**	**Palm**
Model Name	**:**	**T850EWW**
FCC ID	**:**	**O8F-SKYC**
Date of Testing	**:**	**Sep. 11, 2008 ~ Sep. 16, 2008**
Date of Report	**:**	**Oct. 01, 2008**
Date of Review	**:**	**Oct. 01, 2008**

- **Results Summary : M Category = M3 (ANSI C63.19 – 2006)**
- The test results refer exclusively to the presented test model/sample only.
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- Report Version: Rev.01

SPORTON INTERNATIONAL INC.

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1. Statement of Compliance

The Hearing Aid Compliance (HAC) maximum results found during testing for the **Palm, Inc. Smart Phone Palm MC7508** are as follows (with expanded uncertainly ±29.4% for E-field and ±21.8% for H-field):

Band	E-Field (V/m)	M Rating	H-Field (A/m)	M Rating
CDMA2000 Cellular	156.7	M4	0.375	M4
CDMA2000 PCS	65.4	M3	0.206	M3

They are in compliance with HAC limits specified in guidelines FCC 47CFR §20.19 and ANSI Standard ANSI C63.19 for HAC Rated category M3.

Results Summary : M Category = M3 (ANSI C63.19 – 2006)

Approved by

Roy Wu
Manager

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2. Administration Data

2.1 Testing Laboratory

Company Name : Sporton International Inc.
Address : No.52, Hwa-Ya 1st RD., Hwa Ya Technology Park, Kwei-Shan Hsiang, TaoYuan Hsien, Taiwan, R.O.C.
Test Site : SAR01-HY
Telephone Number : 886-3-327-3456
Fax Number : 886-3-328-4978

2.2 Applicant

Company Name : Palm, Inc.
Address : 950 W Maude Ave. MS 22L02 Sunnyvale, CA 94085-2801

2.3 Application Details

Date of reception of application: Sep. 11, 2008
Start of test : Sep. 11, 2008
End of test : Sep. 16, 2008

3. General Information

3.1 Feature of Equipment Under Test

Product Feature & Specification	
Equipment	Smart Phone
Brand Name	Palm
Model Name	T850EWW
FCC ID	O8F-SKYC
Tx Frequency Range	CDMA2000 Cellular : 824 MHz ~ 849 MHz CDMA2000 PCS : 1850 MHz ~ 1910 MHz
Rx Frequency Range	CDMA2000 Cellular : 869 MHz ~ 894 MHz CDMA2000 PCS : 1930 MHz ~ 1990 MHz
Maximum Output Power to Antenna	CDMA2000 Cellular : 23.63 dBm CDMA2000 PCS : 23.82 dBm
Antenna Type	Fixed Internal Antenna
Type of Modulation	QPSK
DUT Stage	Identical Prototype

Accessories List:

Component Model		
AC Adapter	**Brand Name**	Palm
	Model Name	5890-712V-02K0
	Part Number	157-10108-00
	Power Rating	I/P:100-240Vac, 50-60Hz, 0.25A; O/P: 5Vdc, 1000mA
Battery	**Brand Name**	Palm
	Model Name	157-10105-00
	Power Rating	3.7Vdc, 1500mAh
	Type	Li-ion
Earphone	**Brand Name**	Palm
	Model Name	3363WW
	Part Number	180-10611-00
	Signal Line Type	0.9 meter non-shielded cable without ferrite core
USB Cable	**Brand Name**	Palm
	Model Name	3403WW
	Part Number	163-10274-00
	Signal Line Type	1.8 meter non-shielded cable without ferrite core

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. For accessories equipped with this EUT, please refer to the appendix of the external photo.

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3.2 Applied Standards

The ANSI Standard ANSI C63.19:2006 represents performance requirements for acceptable interoperability of hearing aids with wireless communications devices. When these parameters are met, a hearing aid operates acceptably in close proximity to a wireless communications device.

The following AWF factors shall be used for the standard transmission protocols:

Standard	Technology	AWF (dB)
TIA/EIA/IS-2000	CDMA	0
TIA/EIA-136	TDMA (50 Hz)	0
J-STD-007	GSM (217)	-5
T1/T1P1/3GPP	UMTS (WCDMA)	0
iDENTM	TDMA (22 and 11 Hz)	0

Table 3.1 Articulation Weighting Factor (AWF)

Category	Telephone RF Parameters				
Near Field	AWF	E-Field Emissions		H-Field Emissions	
		< 960 MHz			
Category M1	0	631.0 – 1122.0	V/m	1.91 – 3.39	A/m
	-5	473.2 – 841.4	V/m	1.43 – 2.54	A/m
Category M2	0	354.8 – 631.0	V/m	1.07 – 1.91	A/m
	-5	266.1 – 473.2	V/m	0.80 – 1.43	A/m
Category M3	0	199.5 – 354.8	V/m	0.6 – 1.07	A/m
	-5	149.6 – 266.1	V/m	0.45 – 0.80	A/m
Category M4	0	< 199.5	V/m	< 0.60	A/m
	-5	< 149.6	V/m	< 0.45	A/m
		> 960 MHz			
Category M1	0	199.5 – 354.8	V/m	0.60 – 1.07	A/m
	-5	149.6 – 266.1	V/m	0.45 – 0.80	A/m
Category M2	0	112.2 – 199.5	V/m	0.34 – 0.60	A/m
	-5	84.1 – 149.6	V/m	0.25 – 0.45	A/m
Category M3	0	63.1 – 112.2	V/m	0.19 – 0.34	A/m
	-5	47.3 – 84.1	V/m	0.14 – 0.25	A/m
Category M4	0	< 63.1	V/m	< 0.19	A/m
	-5	< 47.3	V/m	< 0.14	A/m

Table 3.2 Telephone near-field categories in linear units

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3.3 Test Conditions

3.3.1 Ambient Condition

Ambient Temperature	20-24℃
Humidity	<60 %

3.3.2 Test Configuration

The device was controlled by using a base station emulator R&S CMU200. Communication between the device and the emulator was established by air link.

Measurements were performed on the low, middle and high channels of both bands.

The DUT was set from the emulator to radiate maximum output power during all tests.

The worst case for CDMA2000 test modes please refer to Appendix D.

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4. Hearing Aid Compliance (HAC)

4.1 Introduction

The federal communication commission (FCC) adopted ANSI C63.19 as HAC test standard.

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5. HAC Measurement Setup

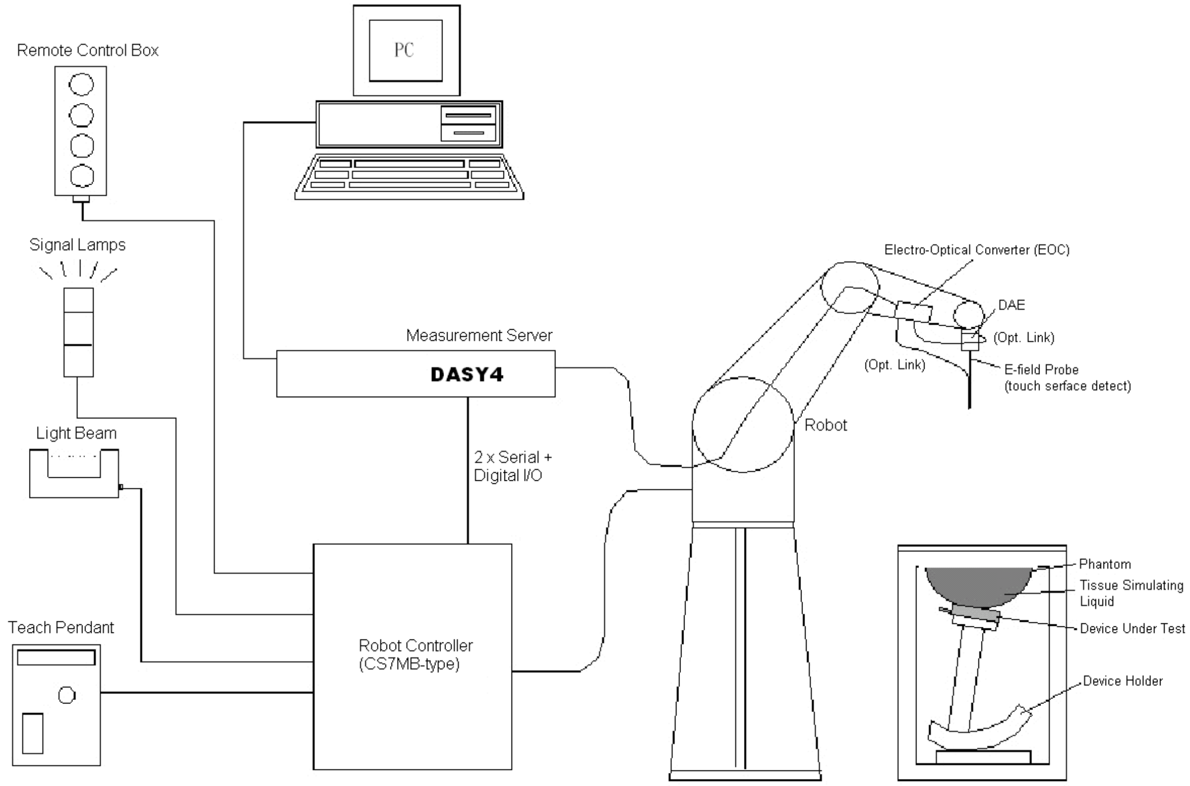

Fig. 5.1 DASY4 system

The DASY4 system for performance compliance tests is illustrated above graphically. This system consists of the following items:

- A standard high precision 6-axis robot with controller, a teach pendant and software
- A data acquisition electronic (DAE) attached to the robot arm extension
- A dosimetric probe equipped with an optical surface detector system
- The electro-optical converter (EOC) performs the conversion between optical and electrical signals
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning
- A computer operating Windows XP
- DASY4 software
- Remove control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.
- The SAM twin phantom
- A device holder
- Dipole for evaluating the proper functioning of the system
- Arch Phantom

Some of the components are described in details in the following sub-sections.

5.1 DASY4 E-Field and H-Field Probe System

The HAC measurement is conducted with the dosimetric probe ER3DV6 and H3DV6 (manufactured by SPEAG). The probe is specially designed and calibrated. This probe has a built in optical surface detection system to prevent from collision with DUT.

5.2 System Specification

5.2.1 ER3DV6 E-Field Probe Description

Construction	One dipole parallel, two dipoles normal to probe axis Built-in shielding against static charges
Calibration	In air from 100 MHz to 3.0 GHz (absolute accuracy ±6.0%, k=2)
Frequency	100 MHz to 6 GHz; Linearity: ± 2.0 dB (100 MHz 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 or better device readings fall well below diode compression point)
Linearity	± 0.2 dB
Dimensions	Overall length: 330 mm (Tip: 16 mm) Tip diameter: 8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.5 mm

Fig. 5.2 E-field Free-space Probe

5.2.2 H3DV6 H-Field Probe Description

Construction	Three concentric loop sensors with 3.8 mm loop diameters Resistively loaded detector diodes for linear response Built-in shielding against static charges
Frequency	200 MHz to 3 GHz (absolute accuracy ± 6.0 %, k=2); Output linearized
Directivity	± 0.25 dB (spherical isotropy error)
Dynamic Range	10 m A/m to 2 A/m at 1 GHz (M3 or better device readings fall well below diode compression point)
Dimensions	Overall length: 330 mm (Tip: 40 mm) Tip diameter: 6 mm (Body: 12 mm) Distance from probe tip to dipole centers: 3 mm
E-Field Interference	< 10% at 3 GHz (for plane wave)

Fig. 5.3 H-field Free-space Probe

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5.2.3 Probe Tip Description

HAC field measurements take place in the close near field with high gradients. Increasing the measuring distance from the source will generally decrease the measured field values (in case of the validation dipole approx. 10%per mm).

Magnetic field sensors are measuring the integral of the H-field across their sensor area surrounded by the loop. They are calibrated in a precise, homogeneous field. When measuring a gradient field, the result will be very close to the field in the center of the loop which is equivalent to the value of a homogeneous field equivalent to the center value. But it will be different from the field at the field at the border of the loop.

Consequently, two sensors with different loop diameters – both calibrated ideally – would give different results when measuring from the edge of the probe sensor elements. The behavior for electrically small E-field sensors is equivalent. See below for distance plots from a WD which show the conservative nature of field readings at the probe element center vs. measurements at the sensor end:

Fig. 5.4 Z-Axis Scan at maximum point above a typical wireless device for E-field

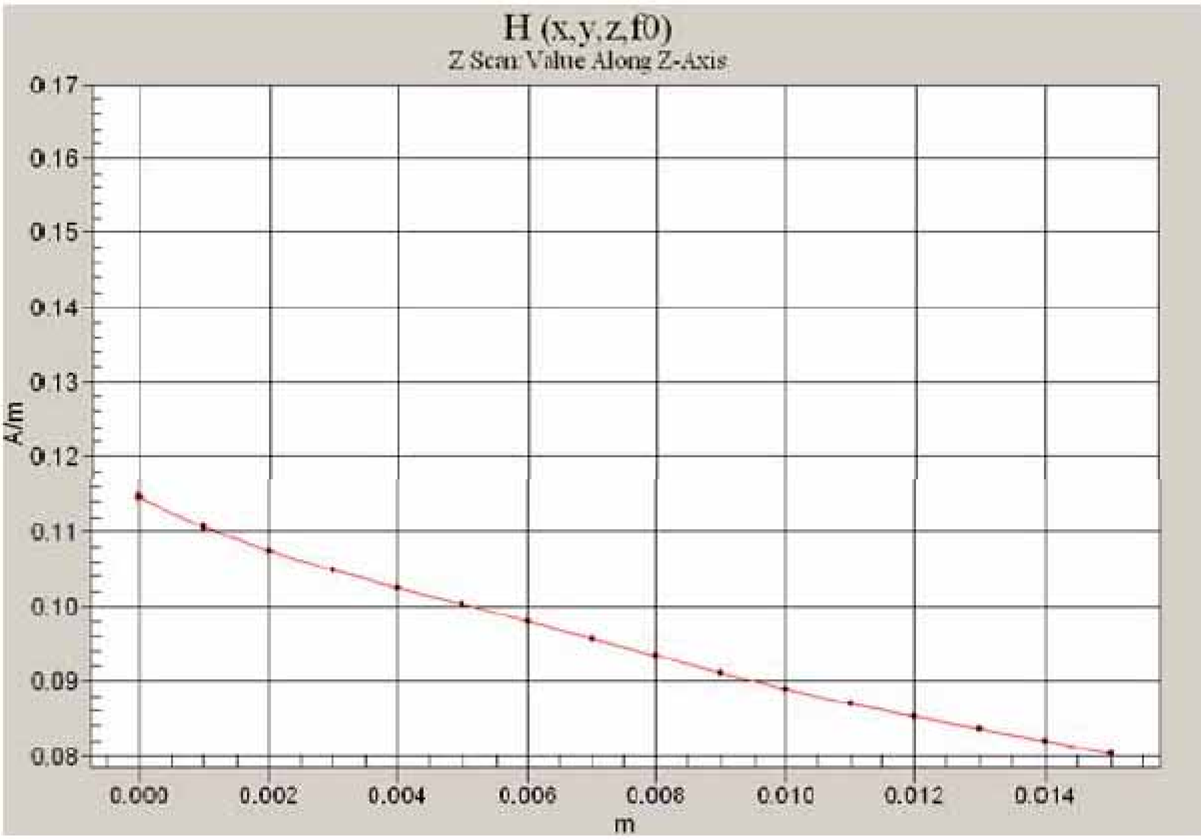

Fig. 5.5 Z-Axis Scan at maximum point above a typical wireless device for H-field

The magnetic field loops of the H3D probes are concentric, with the center 3mm from the tip for H3DV6.
Their radius is 1.9 mm.

The electric field probes have a more irregular internal geometry because it is physically not possible to have the 3 orthogonal sensors situated with the same center. The effect of the different sensor centers is accounted for in the HAC uncertainty budget ("sensor displacement"). Their geometric center is at 2.5 mm from the tip, and the element ends are 1.1 mm closer to the tip.

Where:

Peak Field = Peak field (in dB V/m or dB A/m)
Raw = Raw field measurement from the measurement system (in V/m or A/m).
PMF = Probe Modulation Factor (in Linear units). See Chapter 8 of test report.

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5.3 DATA Acquisition Electronics (DAE)

The data acquisition electronics (DAE3) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

The input impedance of the DAE3 is 200M Ohm; the inputs are symmetrical and floating. Common mode rejection is above 80dB.

5.4 Robot

The DASY4 system uses the high precision robots RX90BL type out of the newer series from Stäubli SA (France). For the 6-axis controller DASY4 system, the CS7MB robot controller version from Stäubli is used. The RX robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller

5.5 Measurement Server

The DASY4 measurement server is based on a PC/104 CPU board with
166 MHz CPU
32 MB chipset and
64 MB RAM.

Communication with
the DAE4 electronic box
the 16-bit AD-converter system for optical detection and digital I/O interface.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.

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5.6 Phone Positioner

The phone positioner shown in Fig. 5.8 is used to adjust DUT to the suitable position.

Fig. 5.6 Phone Positioner

5.6.1 Test Arch Phantom

Construction	Enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot.
Dimensions	370 x 370 x 370 mm

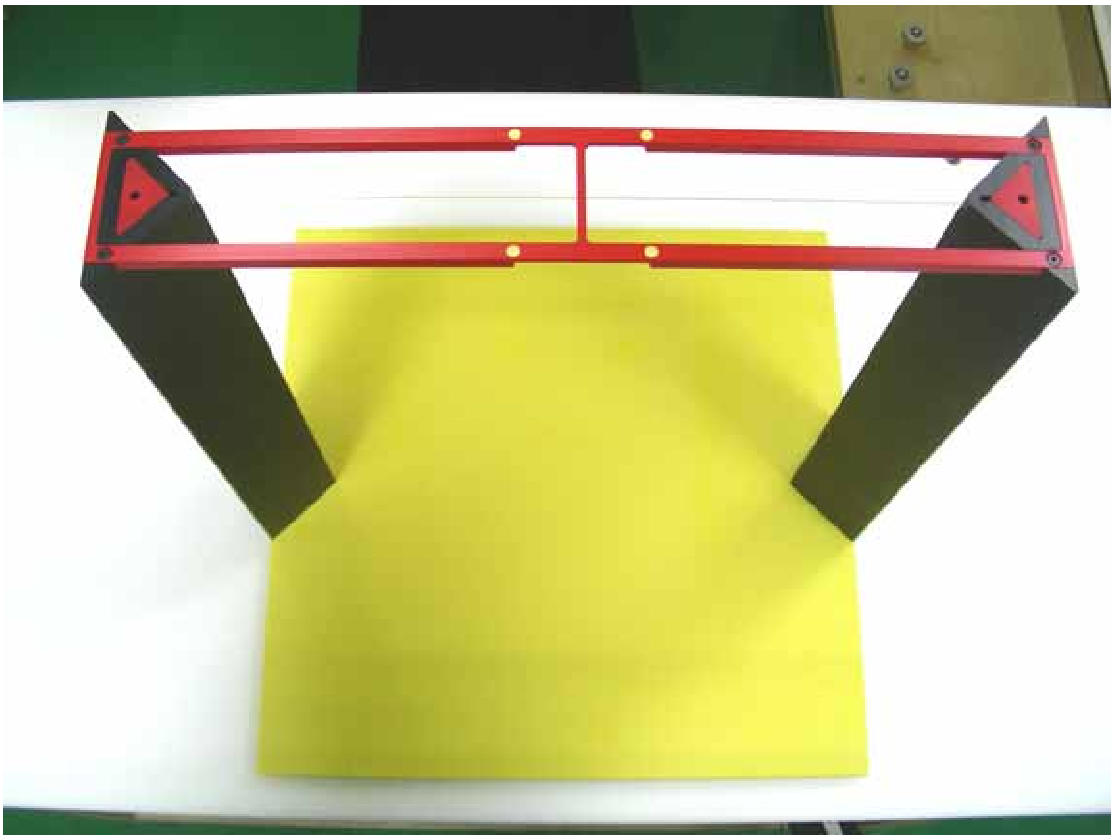

Fig. 5.7 Test Arch Phantom

5.7 Data Storage and Evaluation

5.7.1 Data Storage

The DASY4 software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, and device frequency and modulation data) in measurement files with the extension .DA4. The post-processing 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 erroneous parameter settings.

5.7.2 Data Evaluation

The DASY4 post-processing software (SEMCAD) 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	dcp_i
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 DASY components. In the direct measuring mode of the multi-meter 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：

$$Vi = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

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 : $E_i = \sqrt{\frac{V_i}{Norm_i ConvF}}$

H-field probes : $H_i = \sqrt{V_i}\frac{a_{i0+}a_{i1}f + a_{i2}f^2}{f}$

with
V_i = compensated signal of channel *i* (*i* = x, y, z)
$Norm_i$ = sensor sensitivity of channel i (*i* = x, y, z)
μ V/(V/m)2 for E-field Probes
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) :

$$E_{tot} = \sqrt{E_X^2 + E_Y^2 + E_Z^2}$$

The primary field data are used to calculate the derived field units.

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770} \quad \text{or} \quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

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

The measurement/integration time per point, as specified by the system manufacturer is >500 ms.

The signal response time is evaluated as the time required by the system to reach 90% of the expected final value after an on/off switch of the power source with an integration time of 500 ms and a probe response time of <5 ms. In the current implementation, DASY4 waits longer than 100 ms after having reached the grid point before starting a measurement, i.e., the response time uncertainty is negligible.

If the device under test does not emit a CW signal, the integration time applied to measure the electric field at a specific point may introduce additional uncertainties due to the discretization. The tolerances for the different systems had the worst-case of 2.6%.

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5.8 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Isotropic E-Filed Probe	ER3DV6	2358	Jan. 28, 2008	Jan. 27, 2009
SPEAG	Isotropic H-Filed Probe	H3DV6	6184	Jan. 28, 2008	Jan. 27, 2009
SPEAG	835MHz Calibration Dipole	CD835V3	1045	Sep. 25, 2007	Sep. 24, 2009
SPEAG	1880MHz Calibration Dipole	CD1880V3	1038	Sep. 27, 2007	Sep. 26, 2009
SPEAG	Data Acquisition Electronics	DAE3	577	Nov. 16, 2007	Nov. 15, 2008
SPEAG	Test Arch Phantom	N/A	N/A	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
R&S	Universal Radio Communication Tester	CMU200	103937	Oct. 19, 2007	Oct. 18, 2008
Agilent	Dual Directional Coupler	778D	50422	NCR	NCR
AR	Power Amplifier	5S1G4M2	0328767	NCR	NCR
R&S	Power Meter	NRVD	101394	Oct. 31, 2007	Oct. 30, 2008
R&S	Power Sensor	NRV-Z1	100130	Oct. 31, 2007	Oct. 30, 2008

Table 5.1 Test Equipment List

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6. Uncertainty Assessment

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table 7.1

Uncertainty Distributions	Normal	Rectangular	Triangular	U-shape
Multiplying factor[a]	1/k [b]	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Table 6.1 Multiplying Factions for Various Distributions

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY4 uncertainty Budget is showed in Table 6.2.

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Error Description	Uncertainty Value (± %)	Probability Distribution	Divisor	(Ci) E	(Ci) H	Std. Unc. E	Std. Unc. 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 Effect	± 2.4	Rectangular	√3	1	1	± 1.4	± 1.4
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 Limit	± 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	± 12.0	Rectangular	√3	1	1	± 6.9	± 6.9
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
Extrap. 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
Phantom and Setup Related							
Phantom Thickness	± 2.4	Rectangular	√3	1	0.67	± 1.4	± 0.9
Combined Standard Uncertainty						**± 14.7**	**± 10.9**
Coverage Factor for 95 %		**K=2**					
Expanded uncertainty (Coverage factor = 2)						**± 29.4**	**± 21.8**

Table 6.2 Uncertainty Budget of DASY4

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7. HAC Measurement Evaluation

Each DASY4 system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY4 software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the test Arch and a corresponding distance holder.

7.1 Purpose of System Performance check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal HAC measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

7.2 System Setup

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave which comes from a signal generator at frequency 835 and 1880 MHz. The calibrated dipole must be placed beneath the flat phantom section of the ARC with the correct distance holder. The equipment setup is shown below:

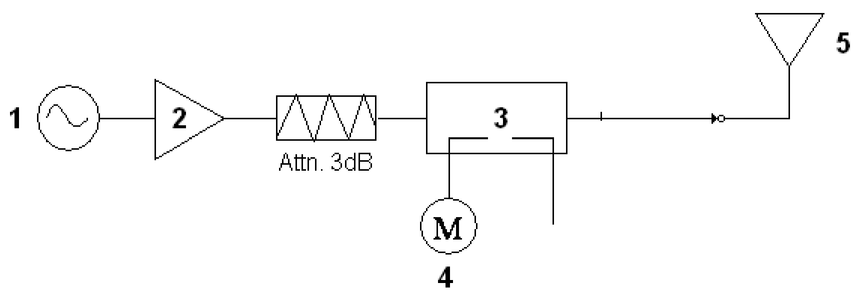

Fig. 7.1 System Setup of System Evaluation

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1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. 835 or 1880 MHz Dipole

The output power on dipole port must be calibrated to 20dBm (100mW) before dipole is connected.

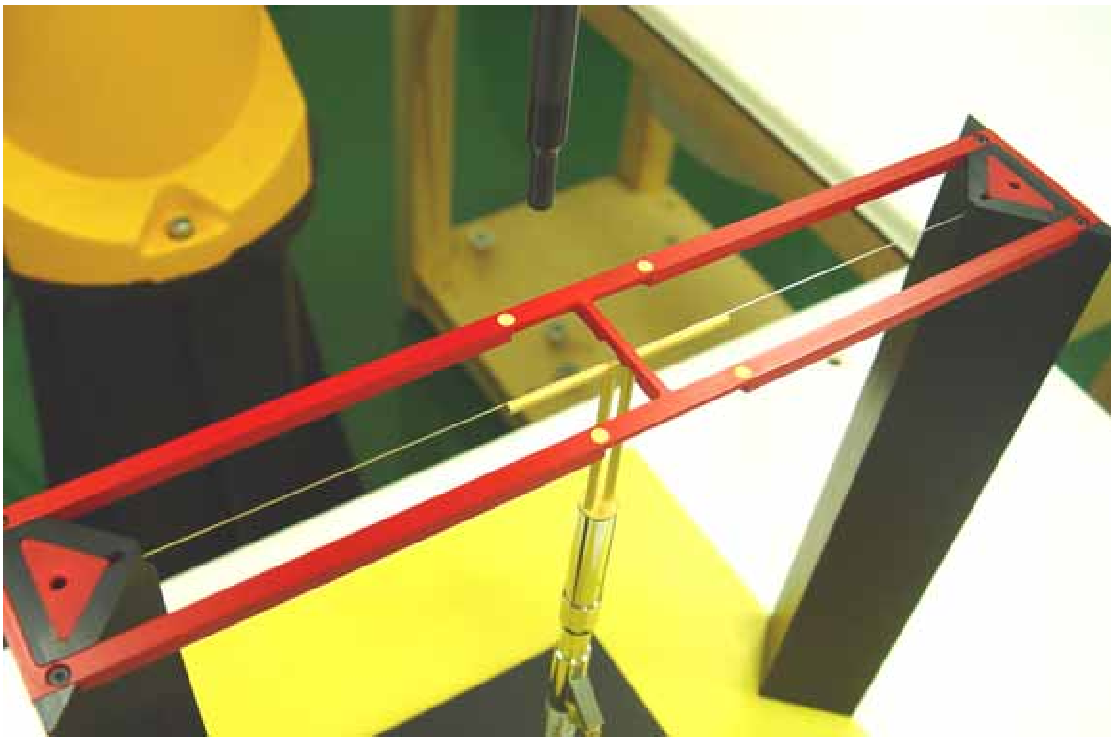

Fig 7.2 Dipole Setup

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7.3 Validation Results

Frequency (MHz)	Input Power (dBm)	E-field Result (V/m)	Target Field (V/m)	Deviation (%)
835	20.0	178	167.1	6.52
1880	20.0	147.75	138.9	6.37

Table 7.1 E-field System Validation

Frequency (MHz)	Input Power (dBm)	H-field Result (A/m)	Target Field (A/m)	Deviation (%)
835	20.0	0.454	0.453	0.22
1880	20.0	0.498	0.471	5.73

Table 7.2 H-field System Validation

Remark: Deviation = ((E or H-field Result) - (Target field)) / (Target field) * 100%

The table above indicates the system performance check can meet the variation criterion, ±25%.

8. RF Field Probe Modulation Factor

A calibration shall be made of the modulation response of the probe and its instrumentation chain. This calibration shall be performed with the field probe, attached to the instrumentation that is to be used with it during the measurement. The response of the probe system to a CW field at the frequency(s) of interest is compared to its response to a modulated signal with equal peak amplitude. The field level of the test signals shall be more than 10 dB above the ambient level and the noise floor of the instrumentation being used. The ratio of the CW reading to that taken with a modulated field shall be applied to the readings taken of modulated fields of the specified type.

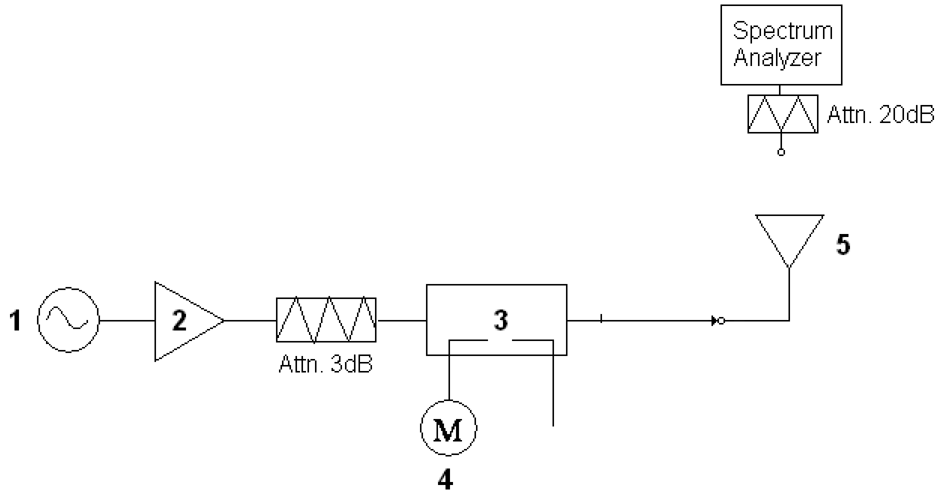

Fig. 8.1 System Calibration

This was done using the following procedure:

1. Fixing the probe in a set location relative to a field generating device.
2. Illuminate the probe with a CW signal at the intended measurement frequency.
3. Record the reading of the probe measurement system of the CW signal.
4. Determine the level of the CW signal being used to drive the field generating device.
5. Substitute a signal using the same modulation as that used by the intended WD for the CW signal.
6. Set the peak amplitude during transmission of the modulated signal to equal the amplitude of the CW signal.
7. Record the reading of the probe measurement system of the modulated signal.
8. The ratio of the CW to modulated signal reading is the modulation factor.
9. Repeat 2~8 steps at intended measurement frequency for both E and H field probe.

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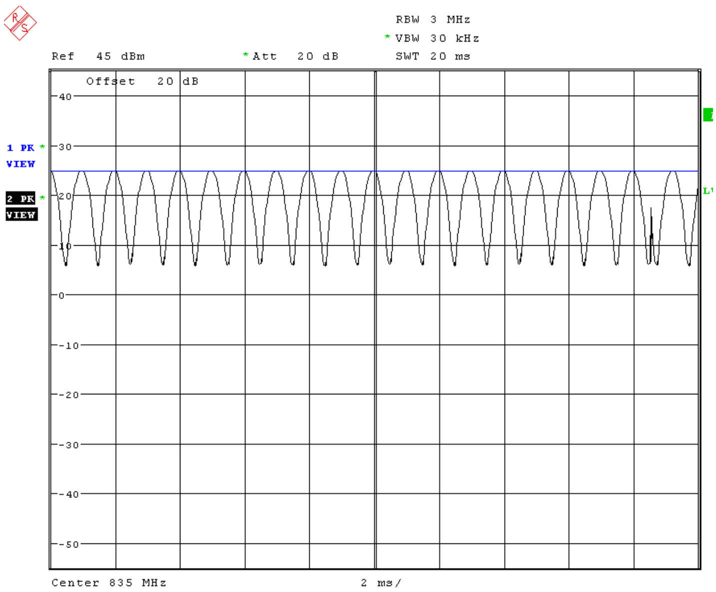
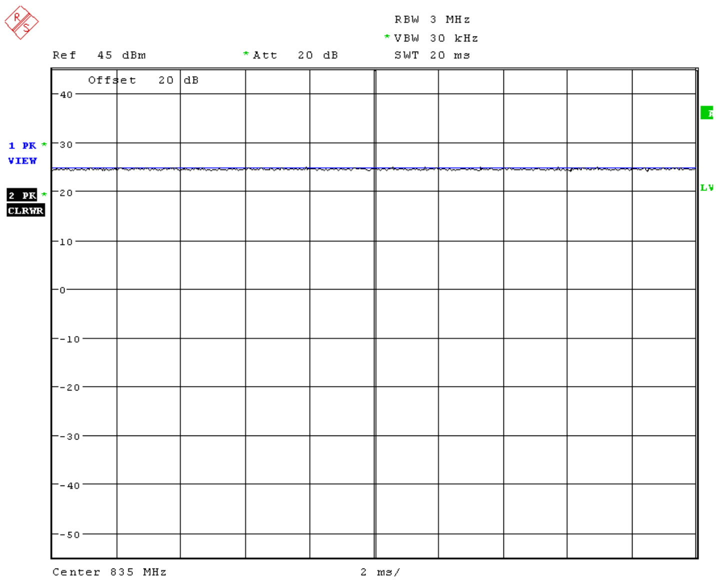
PMF Measurement Summary:

Frequency	Functions	E-field	H-field	PMF	
		V/m	A/m	E-field	H-field
835MHz	CW	265.4	0.755	-	-
835MHz	AM	162.2	0.492	1.64	1.53
835MHz	CDMA	271.1	0.804	0.98	0.94
835MHz	CMDA 1/8	89.15	0.274	2.98	2.75
1880MHz	CW	285.4	0.945	-	-
1880MHz	AM	173.5	0.697	1.64	1.36
1880MHz	CDMA	291.1	1.151	0.98	0.82
1880MHz	CMDA 1/8	92.6	0.35	3.08	2.70

Zero span Spectrum Plots for RF Field Probe Modulation Factor



835MHz - CW and 80% AM



835MHz - CW and CDMA (Full Rate)

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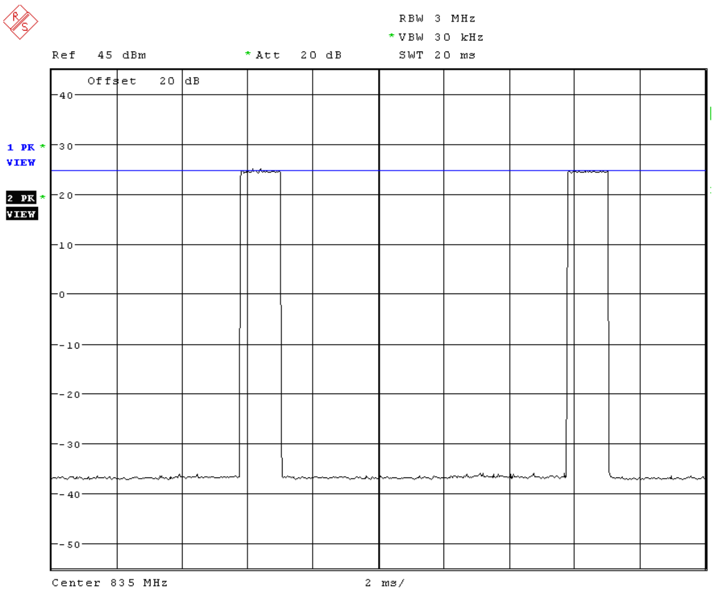
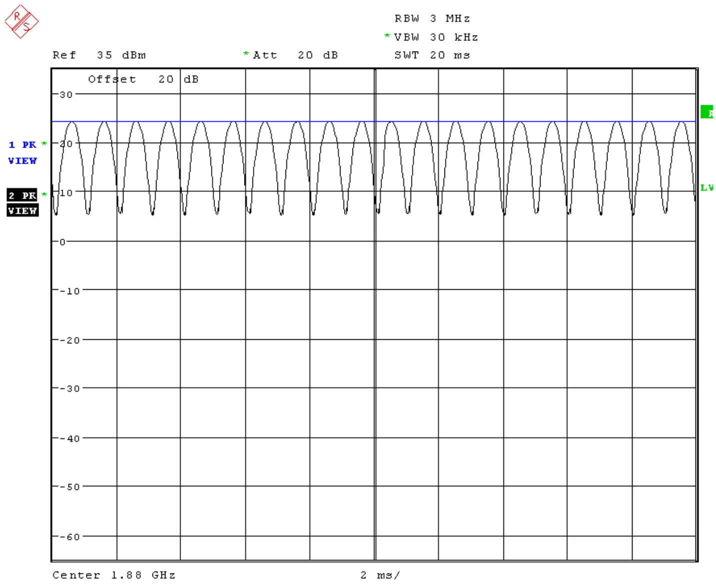
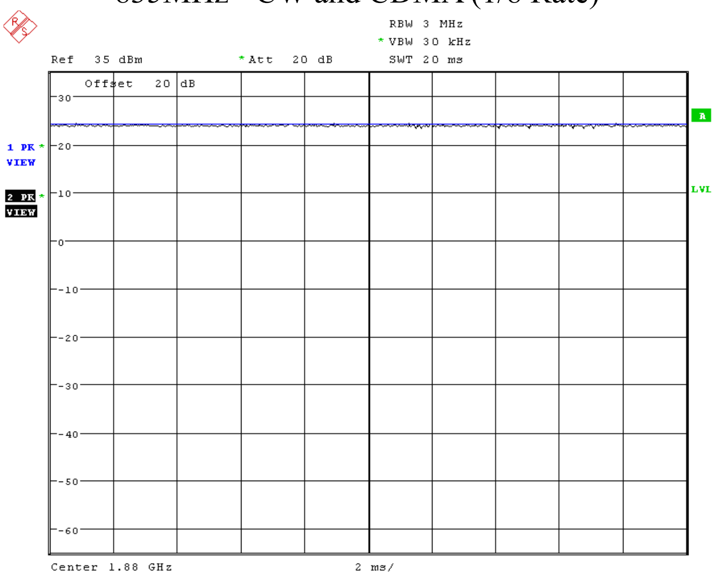


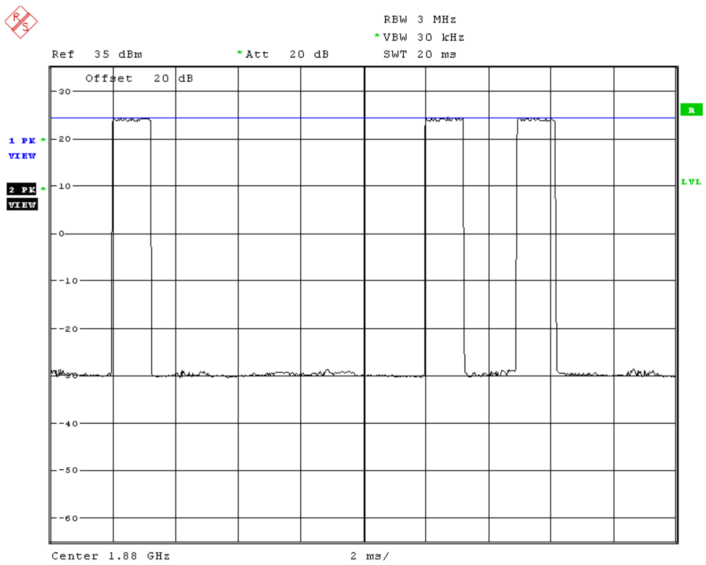
835MHz - CW and CDMA (1/8 Rate)



1880MHz - CW and 80% AM



1880MHz - CW and CDMA (Full Rate)



1880MHz - CW and CDMA (1/8 Rate)

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9. Description for DUT Testing Position

The DUT was put on device holder and adjusted to the accurate and reliable position.
Figure 9.1 illustrate the references and reference plane that shall be used in a typical DUT emissions measurement. The principle of this section is applied to DUT with similar geometry.

- The grid is 5 cm by 5 cm area that is divided into 9 evenly sized blocks or sub-grids.
- The grid is centered on the audio frequency output transducer of the DUT.
- The grid is in a reference plane, which is defined as the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It is parallel to the centerline of the receiver area of the phone and is defined by the points of the receiver-end of the DUT handset, which, in normal handset use, rest against the ear.
- The measurement plane is parallel to, and 1.0 cm in front of, the reference plane.

Figure 9.1: A typical DUT reference and plane for HAC measurements

Remark: Setup photographs refer to Appendix E.

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10. RF Emissions Test Procedure

The following illustrate a typical RF emissions test scan over a wireless communications device:

1. Proper operation of the field probe, probe measurement system, other instrumentation, and the positioning system was confirmed.
2. DUT is positioned in its intended test position, acoustic output point of the device perpendicular to the field probe.
3. The DUT operation for maximum rated RF output power was configured and confirmed with the base station simulator, at the test channel and other normal operating parameters as intended for the test. The battery was ensured to be fully charged before each test.
4. The center sub-grid was centered over the center of the acoustic output (also audio band magnetic output, if applicable). The DUT audio output was positioned tangent (as physically possible) to the measurement plane.
5. A surface calibration was performed before each setup change to ensure repeatable spacing and proper maintenance of the measurement plane using the test Arch.
6. The measurement system measured the field strength at the reference location.
7. Measurements at 5 mm increments in the 5 x 5 cm region were performed and recorded. A 360℃rotation about the azimuth axis at the maximum interpolated position was measured. For the worst-case condition, the peak reading from this rotation was used in re-evaluating the HAC category.
8. The system performed a drift evaluation by measuring the field at the reference location.
9. Steps 1-8 were done for both the E and H-Field measurements.

11. HAC Test Results

11.1 Conducted Power

Band	RC	SO	Type	Data Rate	Conducted Power (dBm)	Conducted Power (dBm)	Conducted Power (dBm)
					Low Ch	Mid Ch	High Ch
CDMA2000 Cellular	**1**	**2**	**Loop**	**Eighth**	23.77	23.75	23.67
CDMA2000 PCS	**1**	**2**	**Loop**	**Eighth**	23.38	23.58	23.48

11.2 E-Field Emission

Mode	Co-location	Back Light	Chan.	Freq. (MHz)	Modulation Type	PMF	Peak Field (V/m)	Power Drift (dB)	M-Rating
CDMA2000 Cellular RC1+SO2	N/A	Off	1013	824.70	QPSK	2.98	154.7	0.048	M4
	N/A	**Off**	**384**	**836.52**	**QPSK**	**2.98**	**156.7**	**0.095**	**M4**
	N/A	Off	777	848.31	QPSK	2.98	151.2	-0.006	M4
	N/A	On	384	836.52	QPSK	2.98	155.6	-0.137	M4
	BT	Off	384	836.52	QPSK	2.98	156.1	-0.023	M4
	WLAN	Off	384	836.52	QPSK	2.98	156.6	-0.115	M4
CDMA2000 PCS RC1+SO2	N/A	Off	25	1851.25	QPSK	3.08	59.1	-0.174	M4
	N/A	Off	600	1880.00	QPSK	3.08	64.7	-0.079	M3
	N/A	Off	1175	1908.75	QPSK	3.08	64.9	-0.225	M3
	N/A	On	1175	1908.75	QPSK	3.08	65.1	-0.283	M3
	BT	**On**	**1175**	**1908.75**	**QPSK**	**3.08**	**65.4**	**-0.23**	**M3**
	WLAN	On	1175	1908.75	QPSK	3.08	65.1	-0.142	M3

11.3 H-Field Emission

Mode	Co-location	Back Light	Chan.	Freq. (MHz)	Modulation Type	PMF	Peak Field (A/m)	Power Drift (dB)	M-Rating
CDMA2000 Cellular RC1+SO2	N/A	Off	1013	824.70	QPSK	2.75	0.363	0.073	M4
	N/A	Off	384	836.52	QPSK	2.75	0.36	0.072	M4
	N/A	Off	777	848.31	QPSK	2.75	0.339	0.05	M4
	N/A	On	1013	824.70	QPSK	2.75	0.371	-0.104	M4
	BT	**On**	**1013**	**824.70**	**QPSK**	**2.75**	**0.375**	**0.075**	**M4**
	WLAN	On	1013	824.70	QPSK	2.75	0.374	0.041	M4
CDMA2000 PCS RC1+SO2	N/A	Off	25	1851.25	QPSK	2.70	0.2	-0.014	M3
	N/A	Off	600	1880.00	QPSK	2.70	0.204	0.058	M3
	N/A	Off	1175	1908.75	QPSK	2.70	0.198	-0.106	M3
	N/A	On	600	1880.00	QPSK	2.70	0.201	-0.035	M3
	BT	**Off**	**600**	**1880.00**	**QPSK**	**2.70**	**0.206**	**0.06**	**M3**
	WLAN	Off	600	1880.00	QPSK	2.70	0.201	-0.037	M3

Remark :

1. The device was chosen to be tested in the worst case peak H-Field condition under RC1/SO2.
2. The output power is adjusted to maximum level during RF Emission test.
3. Test Engineer：Jason Wang , Eric Huang, Robert Liu, and Gordon Lin

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12. References

[1] ANSI C63.19-2006, “American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids”
[2] DASY4 System Hand book.

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Appendix A - System Performance Check Data

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2008/9/16

HAC_E_Dipole_835

DUT: HAC-Dipole 835 MHz

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Ambient Temperature：22.6 ℃

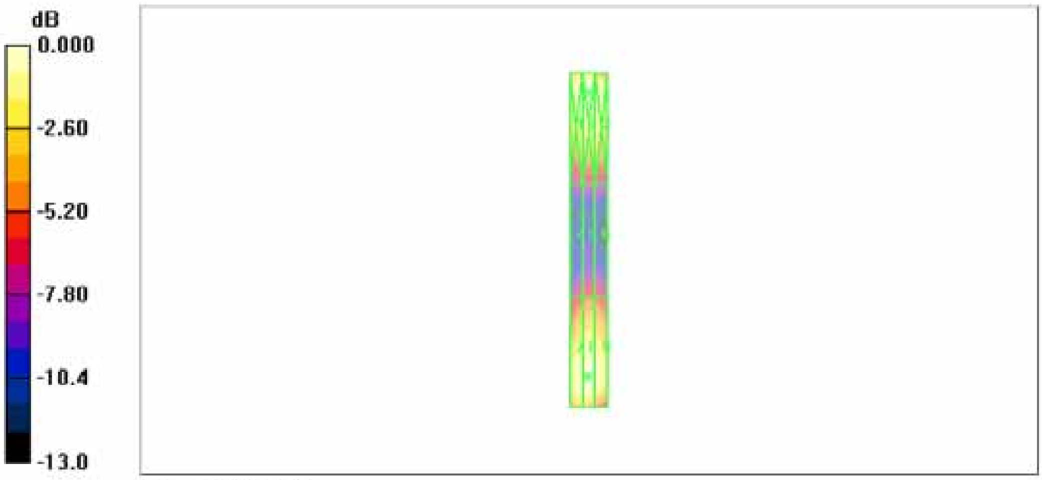
DASY4 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2008/1/28
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2007/11/16
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

E Scan - ER probe center 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 173.1 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 60.8 V/m; Power Drift = -0.088 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **176.4 M4**	Grid 2 **182.9 M4**	Grid 3 **176.0 M4**
Grid 4 **91.1 M4**	Grid 5 **95.8 M4**	Grid 6 **93.5 M4**
Grid 7 **169.5 M4**	Grid 8 **173.1 M4**	Grid 9 **167.1 M4**

Cursor:
Total = 182.9 V/m
E Category: M4
Location: 0, -79, 363.7 mm



0 dB = 182.9V/m

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Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2008/9/11

HAC_E_Dipole_1880

DUT: HAC Dipole 1880 MHz

Communication System: CW; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Ambient Temperature : 22.7 ℃

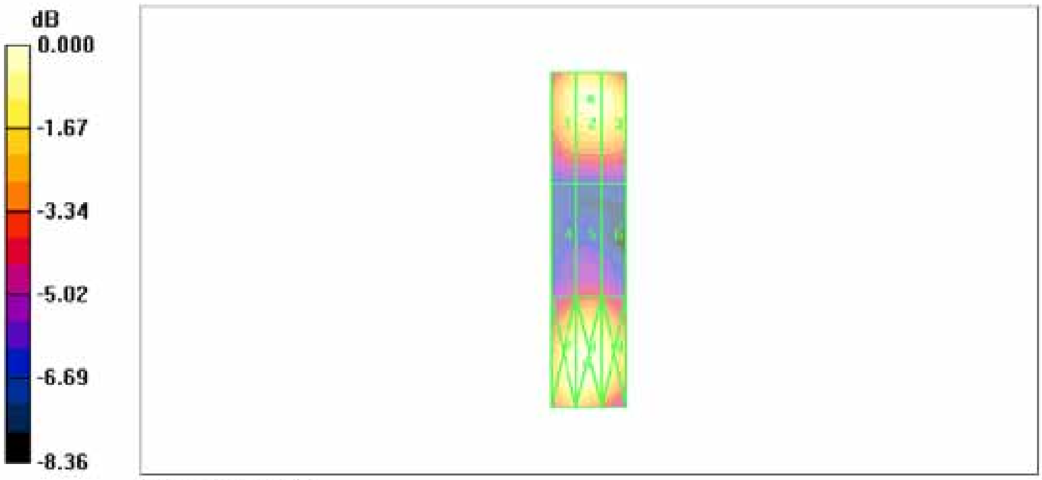
DASY4 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2008/1/28
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2007/11/16
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

E Scan - ER probe center 10mm above CD1880 Dipole/Hearing Aid Compatibility Test (41x181x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 147.6 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 71.9 V/m; Power Drift = -0.001 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **139.0 M2**	Grid 2 **147.6 M2**	Grid 3 **143.9 M2**
Grid 4 **91.9 M3**	Grid 5 **95.8 M3**	Grid 6 **92.9 M3**
Grid 7 **145.4 M2**	Grid 8 **147.9 M2**	Grid 9 **142.1 M2**

Cursor:
Total = 147.9 V/m
E Category: M2
Location: 0.5, 33.5, 363.7 mm



0 dB = 147.9V/m

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Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2008/9/16

HAC_H_Dipole_835

DUT: HAC-Dipole 835 MHz

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Ambient Temperature : 22.6 ℃

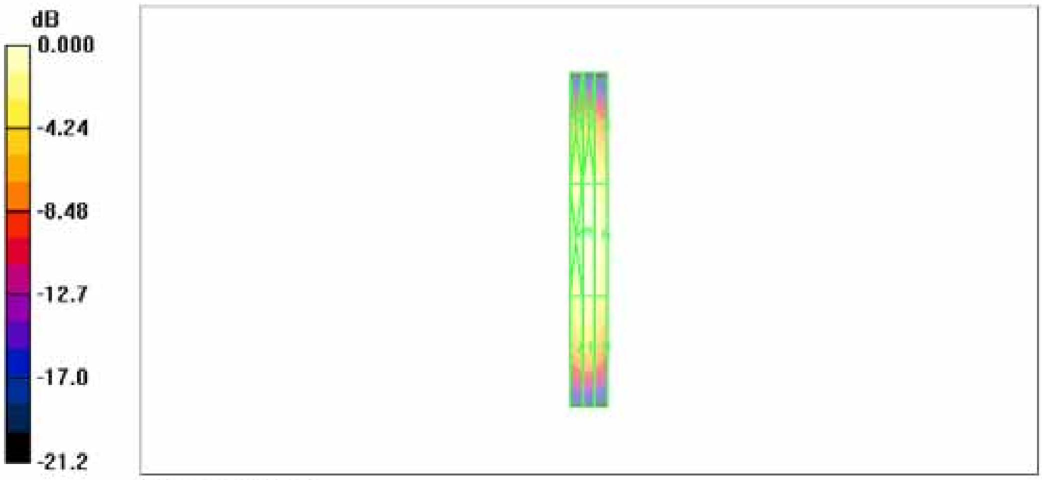
DASY4 Configuration:
- Probe: H3DV6 - SN6184; ; Calibrated: 2008/1/28
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2007/11/16
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

H Scan - H3DV6 probe center 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.454 A/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 0.442 A/m; Power Drift = 0.002 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.379 M4**	Grid 2 **0.401 M4**	Grid 3 **0.372 M4**
Grid 4 **0.434 M4**	Grid 5 **0.454 M4**	Grid 6 **0.421 M4**
Grid 7 **0.378 M4**	Grid 8 **0.397 M4**	Grid 9 **0.367 M4**

Cursor:
Total = 0.454 A/m
H Category: M4
Location: 0.5, -4.5, 363.7 mm



0 dB = 0.454A/m

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Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2008/9/11

HAC_H_Dipole_1880

DUT: HAC Dipole 1880 MHz

Communication System: CW; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Ambient Temperature : 22.5 ℃

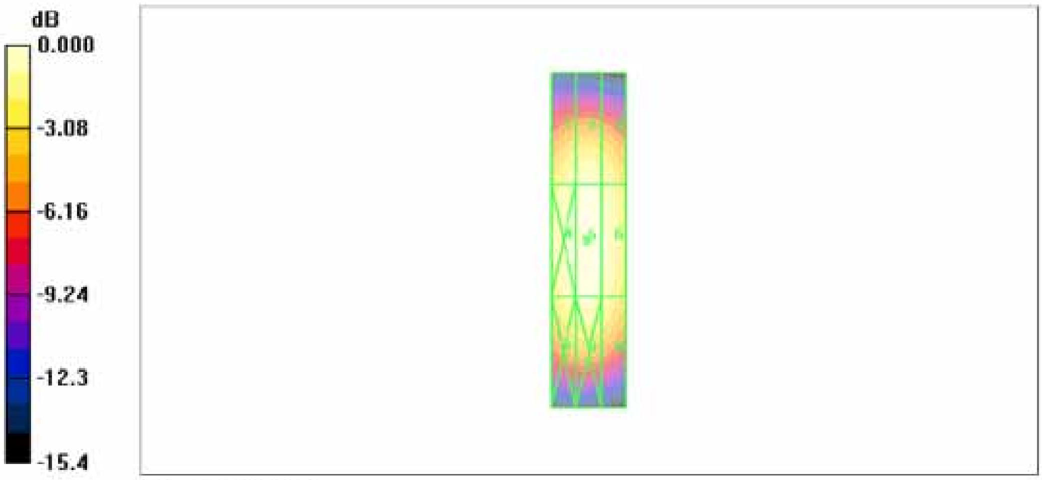
DASY4 Configuration:
- Probe: H3DV6 - SN6184; ; Calibrated: 2008/1/28
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2007/11/16
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

H Scan - HSDV6 probe center 10mm above CD1880 Dipole/Hearing Aid Compatibility Test (41x181x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.498 A/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 0.485 A/m; Power Drift = 0.004 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.439 M2**	Grid 2 **0.459 M2**	Grid 3 **0.429 M2**
Grid 4 **0.481 M2**	Grid 5 **0.498 M2**	Grid 6 **0.465 M2**
Grid 7 **0.443 M2**	Grid 8 **0.461 M2**	Grid 9 **0.425 M2**

Cursor:
Total = 0.498 A/m
H Category: M2
Location: 0.5, 0, 363.7 mm



0 dB = 0.498A/m

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Appendix B - HAC Measurement Data

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2008/9/16

HAC_E_CDMA850_Ch384_RC1_SO2_Loop_Eighth_YE2-6008

DUT: 815187

Communication System: CDMA ; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Ambient Temperature：22.6 ℃

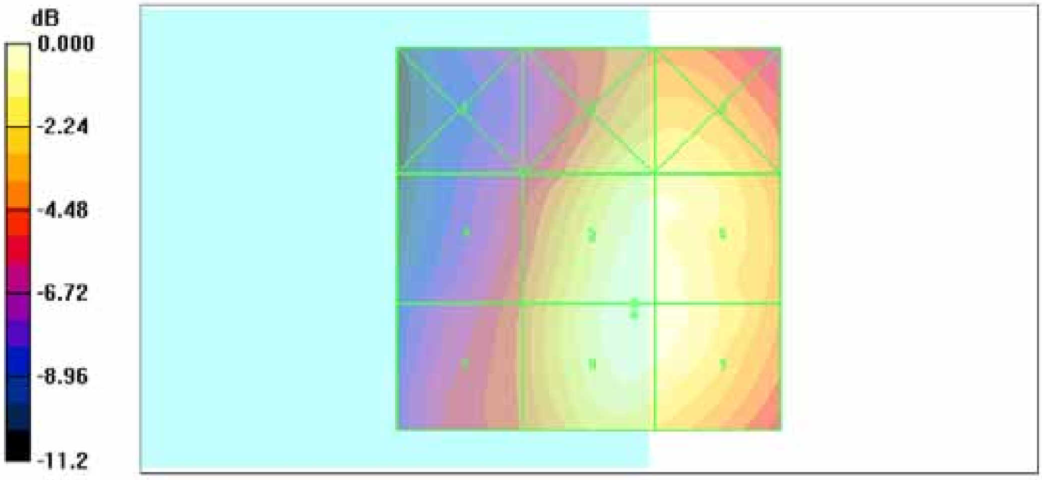
DASY4 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2008/1/28
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2007/11/16
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Ch384/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 156.7 V/m
Probe Modulation Factor = 2.98
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 49.3 V/m; Power Drift = 0.095 dB
Test Arch Compensation is Applied.
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **78.0 M4**	Grid 2 **134.8 M4**	Grid 3 **135.8 M4**
Grid 4 **95.5 M4**	Grid 5 **156.0 M4**	Grid 6 **152.9 M4**
Grid 7 **97.7 M4**	Grid 8 **156.7 M4**	Grid 9 **152.8 M4**

Cursor:
Total = 156.7 V/m
E Category: M4
Location: -6, 10, 364.8 mm



0 dB = 156.7V/m

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Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2008/9/12

HAC_E_CDMA1900_Ch1175_RC1_SO2_Loop_Eighth_Bluetooth on_YE2-6008

DUT: 815187

Communication System: CDMA ; Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Ambient Temperature：22.6 ℃

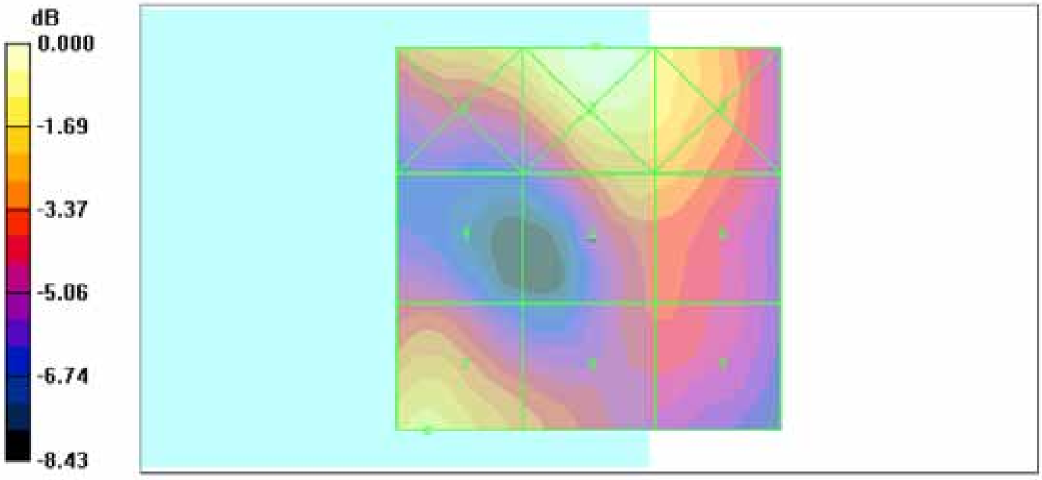
DASY4 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2008/1/28
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2007/11/16
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Ch1175/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 65.4 V/m
Probe Modulation Factor = 3.08
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 14.9 V/m; Power Drift = -0.230 dB
Test Arch Compensation is Applied.
Hearing Aid Near-Field Category: M3 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **65.9 M3**	Grid 2 **77.2 M3**	Grid 3 **67.6 M3**
Grid 4 **47.4 M4**	Grid 5 **58.0 M4**	Grid 6 **57.9 M4**
Grid 7 **65.4 M3**	Grid 8 **54.4 M4**	Grid 9 **49.6 M4**

Cursor:
Total = 77.2 V/m
E Category: M3
Location: -1, -25, 364.8 mm



0 dB = 77.2V/m

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Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2008/9/16

HAC_H_CDMA850_Ch1013_RC1_SO2_Loop_Eighth_Bluetooth on_YE2-6008

DUT: 815187

Communication System: CDMA ; Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Ambient Temperature：22.7 ℃

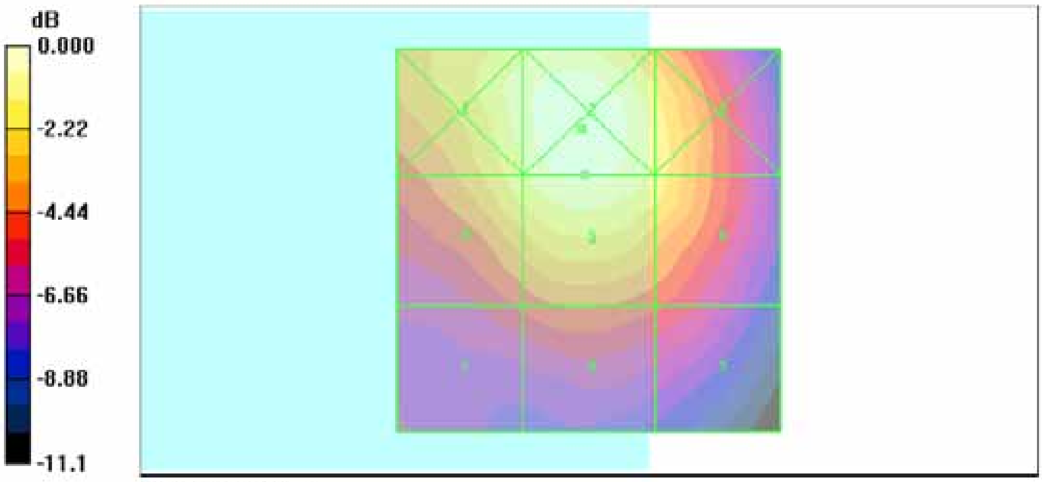
DASY4 Configuration:
- Probe: H3DV6 - SN6184; ; Calibrated: 2008/1/28
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2007/11/16
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Ch1013/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.375 A/m
Probe Modulation Factor = 2.75
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 0.123 A/m; Power Drift = 0.075 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.355 M4**	Grid 2 **0.398 M4**	Grid 3 **0.332 M4**
Grid 4 **0.330 M4**	Grid 5 **0.375 M4**	Grid 6 **0.327 M4**
Grid 7 **0.224 M4**	Grid 8 **0.241 M4**	Grid 9 **0.224 M4**

Cursor:
Total = 0.398 A/m
H Category: M4
Location: 1, -14.5, 365.6 mm



0 dB = 0.398A/m

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Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2008/9/12

HAC_H_CDMA1900_Ch600_RC1_SO2_Loop_Eighth_Bluetooth on_YE2-6008

DUT: 815187

Communication System: CDMA ; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Ambient Temperature：22.7 ℃

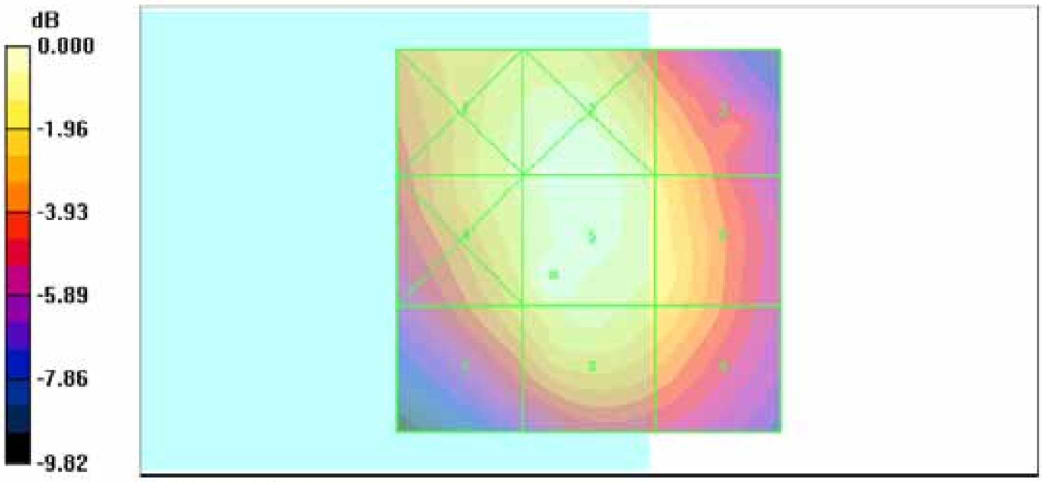
DASY4 Configuration:
- Probe: H3DV6 - SN6184; ; Calibrated: 2008/1/28
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2007/11/16
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Ch600/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.206 A/m
Probe Modulation Factor = 2.70
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 0.082 A/m; Power Drift = 0.060 dB
Hearing Aid Near-Field Category: M3 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.185 M4**	Grid 2 **0.204 M3**	Grid 3 **0.169 M4**
Grid 4 **0.184 M4**	Grid 5 **0.206 M3**	Grid 6 **0.177 M4**
Grid 7 **0.162 M4**	Grid 8 **0.187 M4**	Grid 9 **0.169 M4**

Cursor:
Total = 0.206 A/m
H Category: M3
Location: 4.5, 4.5, 365.6 mm



0 dB = 0.206A/m

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Appendix C – Calibration Data

Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Sporton (Auden)**

Certificate No: **ER3-2358_Jan08**

CALIBRATION CERTIFICATE

Object	ER3DV6 - SN:2358
Calibration procedure(s)	QA CAL-02.v5 Calibration procedure for E-field probes optimized for close near field evaluations in air
Calibration date:	January 28, 2008
Condition of the calibrated item	In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41495277	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41498087	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Reference 3 dB Attenuator	SN: S5054 (3c)	8-Aug-07 (METAS, No. 217-00719)	Aug-08
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-07 (METAS, No. 217-00671)	Mar-08
Reference 30 dB Attenuator	SN: S5129 (30b)	8-Aug-07 (METAS, No. 217-00720)	Aug-08
Reference Probe ER3DV6	SN: 2328	2-Oct-07 (SPEAG, No. ER3-2328_Oct07)	Oct-08
DAE4	SN: 654	20-Apr-07 (SPEAG, No. DAE4-654_Apr07)	Apr-08
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-07)	In house check: Oct-08

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: January 28, 2008

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Certificate No: ER3-2358_Jan08 Page 1 of 9

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

NORMx,y,z	sensitivity in free space
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1309-2005, " IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", December 2005.

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 for XY sensors and ϑ = 90 for Z sensor (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart).
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency.
- *Spherical isotropy (3D deviation from isotropy)*: in a locally homogeneous field realized using an open waveguide setup.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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ER3DV6 SN:2358 January 28, 2008

Probe ER3DV6

SN:2358

Manufactured: July 7, 2005
Last calibrated: February 21, 2007
Recalibrated: January 28, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: ER3-2358_Jan08 Page 3 of 9

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ER3DV6 SN:2358 January 28, 2008

DASY - Parameters of Probe: ER3DV6 SN:2358

Sensitivity in Free Space [µV/(V/m)^2]

NormX	**1.70** ± 10.1 % (k=2)
NormY	**1.55** ± 10.1 % (k=2)
NormZ	**1.61** ± 10.1 % (k=2)

Diode Compression[A]

DCP X	**92** mV
DCP Y	**92** mV
DCP Z	**96** mV

Frequency Correction

X	**0.0**
Y	**0.0**
Z	**0.0**

Sensor Offset (Probe Tip to Sensor Center)

X	**2.5** mm
Y	**2.5** mm
Z	**2.5** mm

Connector Angle **-243** °

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] numerical linearization parameter: uncertainty not required

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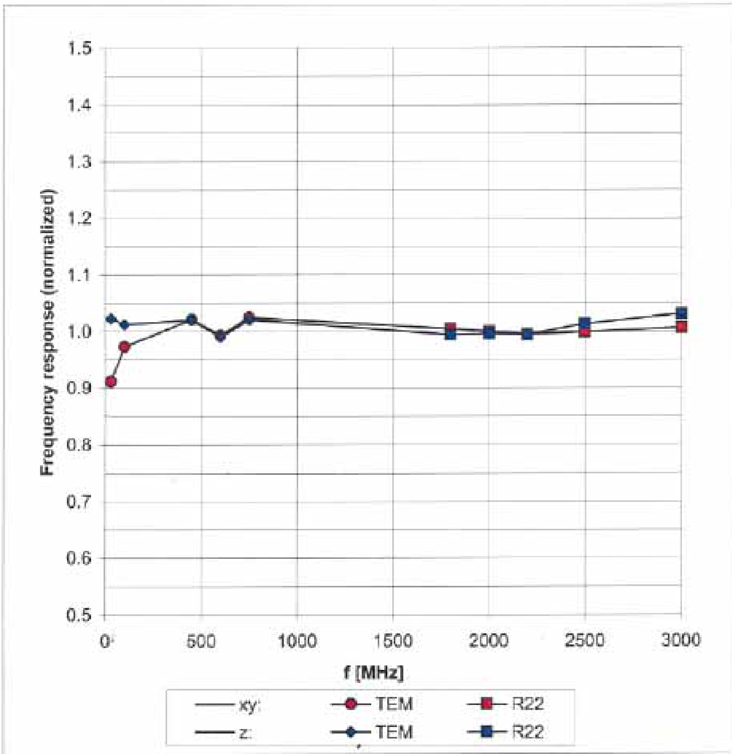
ER3DV6 SN:2358 January 28, 2008

Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide R22)



Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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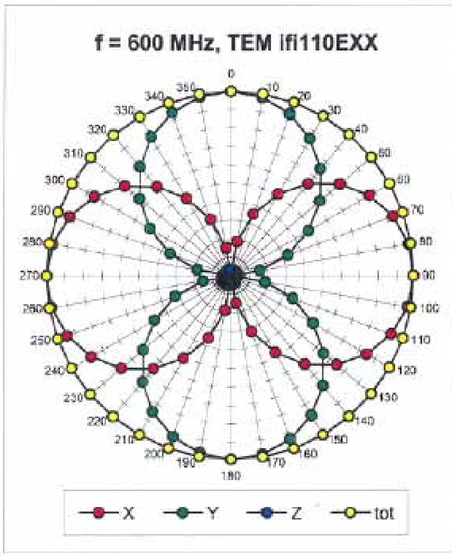
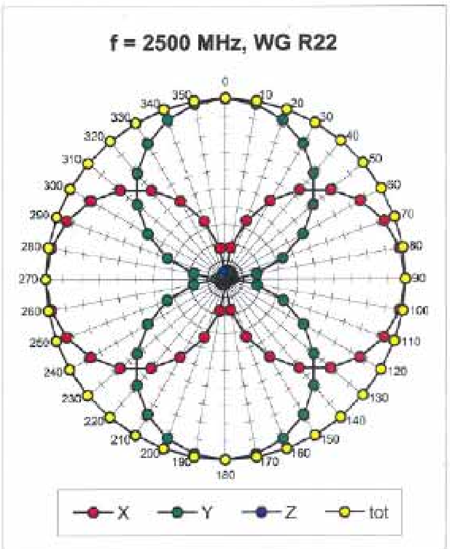
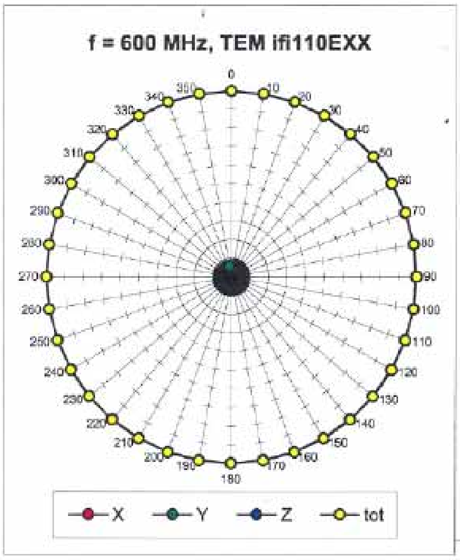
ER3DV6 SN:2358 January 28, 2008

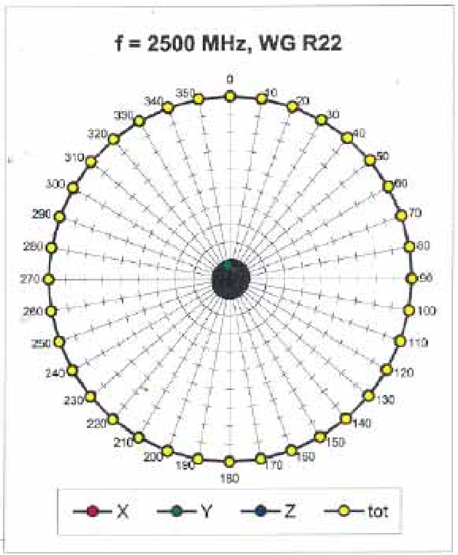
Receiving Pattern (ϕ), ϑ = 0°





Receiving Pattern (ϕ), ϑ = 90°





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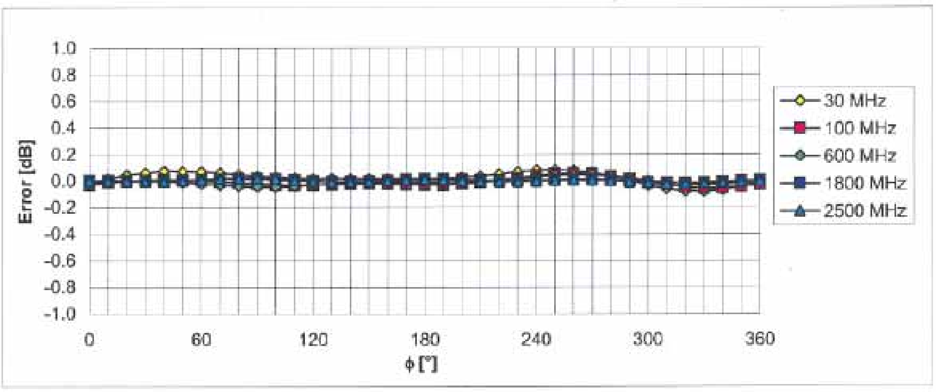
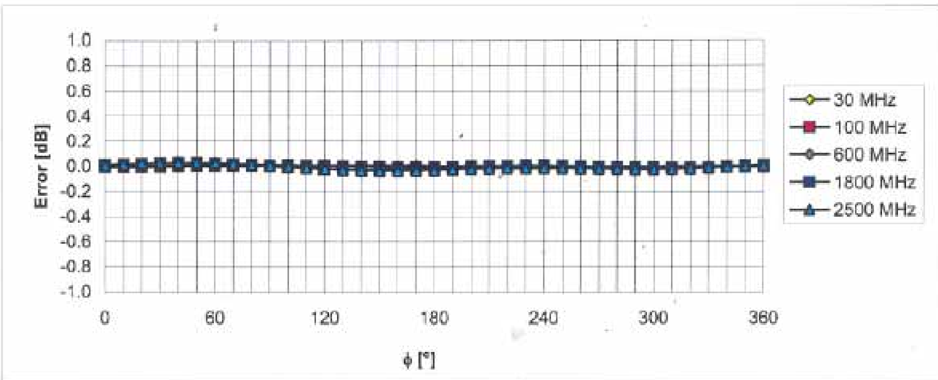
ER3DV6 SN:2358 January 28, 2008

Receiving Pattern (ϕ), ϑ = 0°



Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Receiving Pattern (ϕ), ϑ = 90°



Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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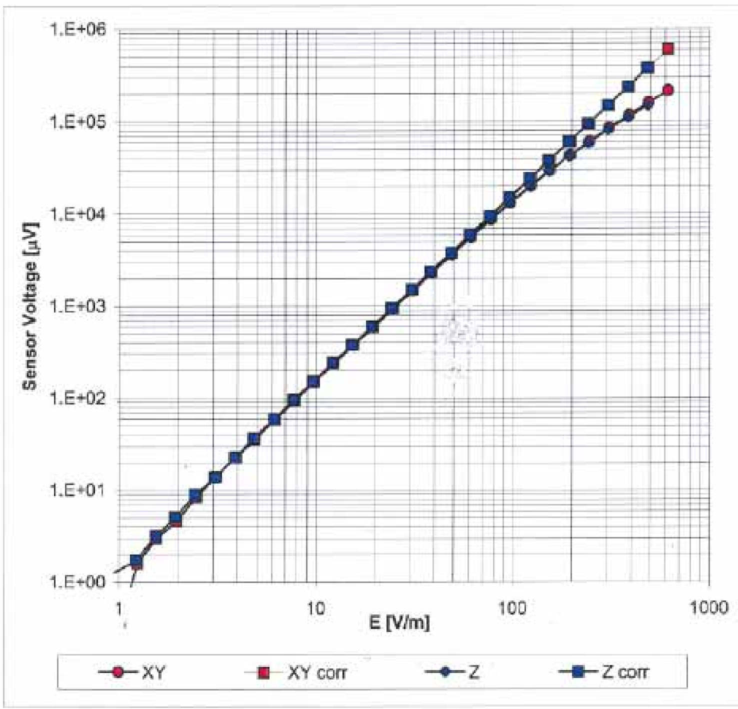
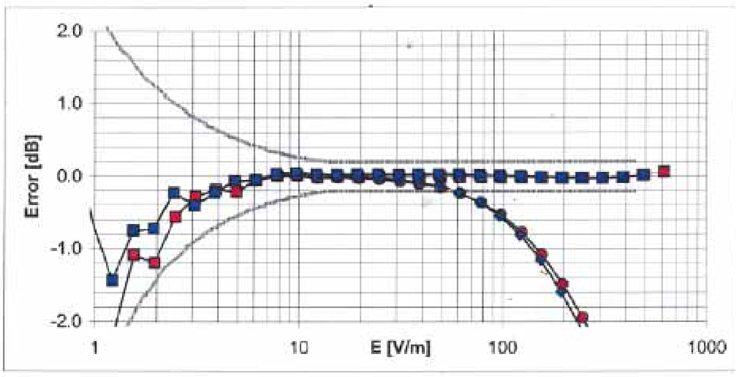
ER3DV6 SN:2358 January 28, 2008

Dynamic Range f(E-field)

(Waveguide R22, f = 1800 MHz)





Uncertainty of Linearity Assessment: ± 0.6% (k=2)

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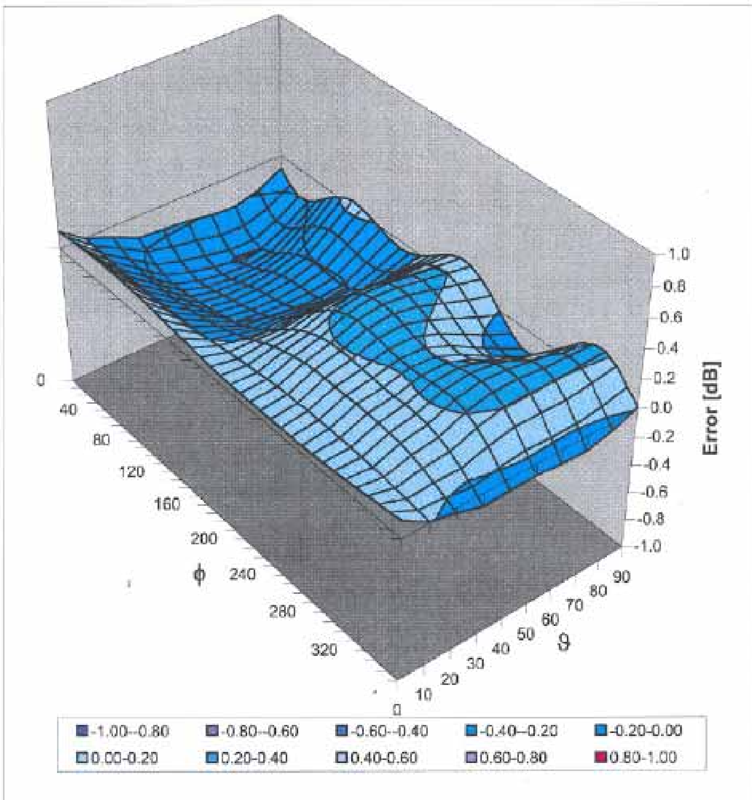
ER3DV6 SN:2358

January 28, 2008

Deviation from Isotropy in Air
Error (ϕ, ϑ) , f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

Certificate No: ER3-2358_Jan08

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Accreditation No.: **SCS 108**

Client **Sporton (Auden)**

Certificate No: **H3-6184_Jan08**

CALIBRATION CERTIFICATE

Object	H3DV6 - SN:6184
Calibration procedure(s)	QA CAL-03.v5 Calibration procedure for H-field probes optimized for close near field evaluations in air
Calibration date:	January 28, 2008
Condition of the calibrated item	In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41495277	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41498087	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Reference 3 dB Attenuator	SN: S5054 (3c)	8-Aug-07 (METAS, No. 217-00719)	Aug-08
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-07 (METAS, No. 217-00671)	Mar-08
Reference 30 dB Attenuator	SN: S5129 (30b)	8-Aug-07 (METAS, No. 217-00720)	Aug-08
Reference Probe H3DV6	SN: 6182	2-Oct-07 (SPEAG, No. H3-6182_Oct07)	Oct-08
DAE4	SN: 654	20-Apr-07 (SPEAG, No. DAE4-654_Apr07)	Apr-08

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-07)	In house check: Oct-08

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: January 28, 2008

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Certificate No: H3-6184_Jan08　　Page 1 of 8

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

NORMx,y,z	sensitivity in free space
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1309-2005, " IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", December 2005.

Methods Applied and Interpretation of Parameters:

- *X,Y,Z_a0a1a2:* Assessed for E-field polarization ϑ = 90 for XY sensors and ϑ = 0 for Z sensor (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide).
- *X,Y,Z(f)_a0a1a2= X,Y,Z_a0a1a2* frequency_response* (see Frequency Response Chart).
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency.
- *Spherical isotropy (3D deviation from isotropy)*: in a locally homogeneous field realized using an open waveguide setup.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *X_a0a1a2* (no uncertainty required).

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Probe H3DV6

SN:6184

Manufactured:	June 8, 2004
Last calibrated:	February 21, 2007
Recalibrated:	January 28, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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H3DV6 SN:6184 January 28, 2008

DASY - Parameters of Probe: H3DV6 SN:6184

Sensitivity in Free Space [A/m / √(μV)]

	a0	a1	a2
X	**2.409E-03**	**6.763E-5**	**-9.365E-6** ± 5.1 % (k=2)
Y	**2.502E-03**	**-4.500E-5**	**-8.887E-6** ± 5.1 % (k=2)
Z	**2.915E-03**	**-3.422E-5**	**4.661E-5** ± 5.1 % (k=2)

Diode Compression[1]

DCP X	**84** mV
DCP Y	**84** mV
DCP Z	**85** mV

Sensor Offset (Probe Tip to Sensor Center)

X	**3.0** mm
Y	**3.0** mm
Z	**3.0** mm

Connector Angle **-244** °

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[1] numerical linearization parameter: uncertainty not required

Certificate No: H3-6184_Jan08 Page 4 of 8

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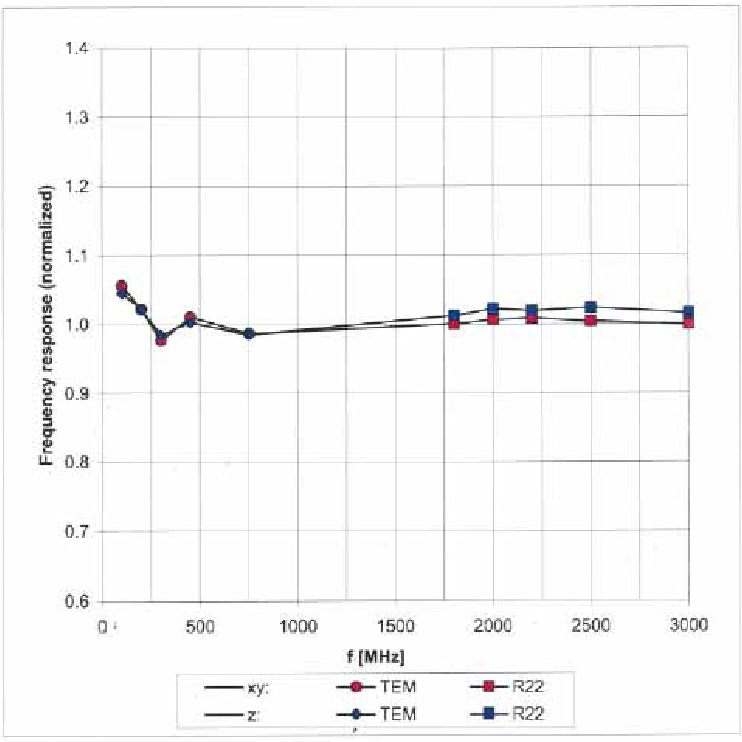
H3DV6 SN:6184 January 28, 2008

Frequency Response of H-Field

(TEM-Cell:ifi110, Waveguide R22)



Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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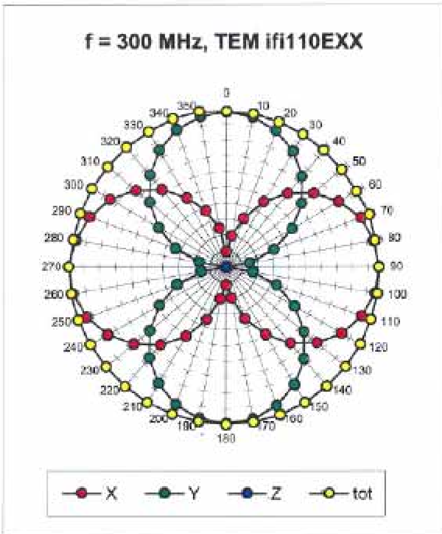
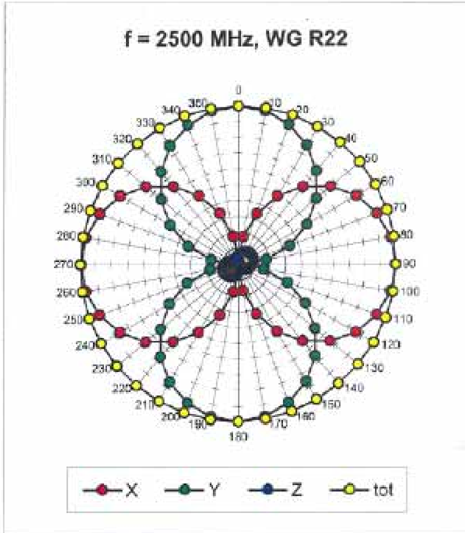
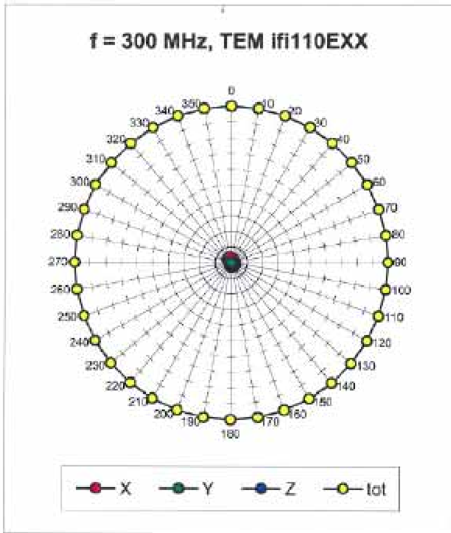
H3DV6 SN:6184 January 28, 2008

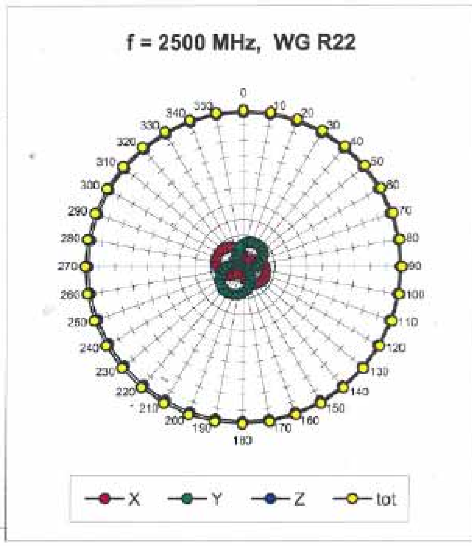
Receiving Pattern (ϕ), $\vartheta = 90°$





Receiving Pattern (ϕ), $\vartheta = 0°$





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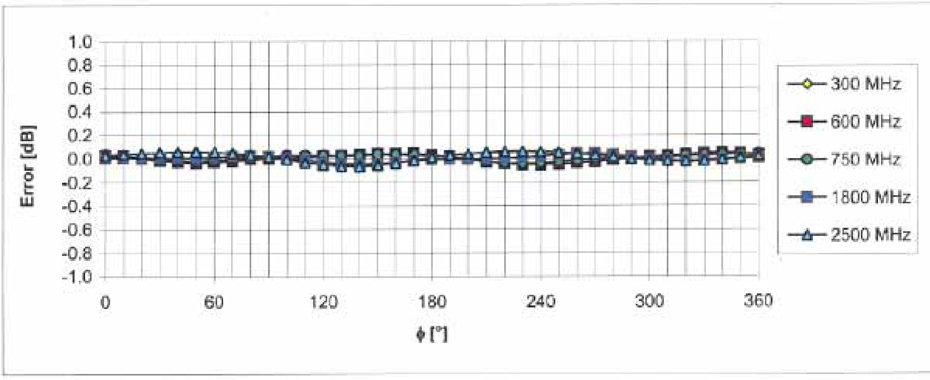
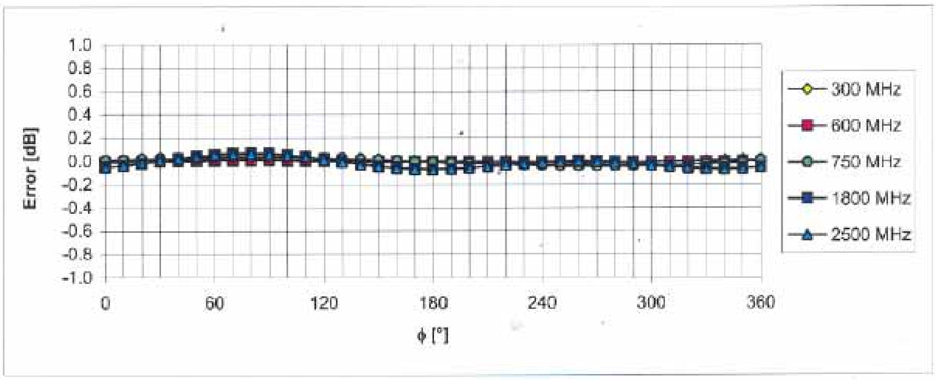
H3DV6 SN:6184 January 28, 2008

Receiving Pattern (ϕ), ϑ = 90°



Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Receiving Pattern (ϕ), ϑ = 0°



Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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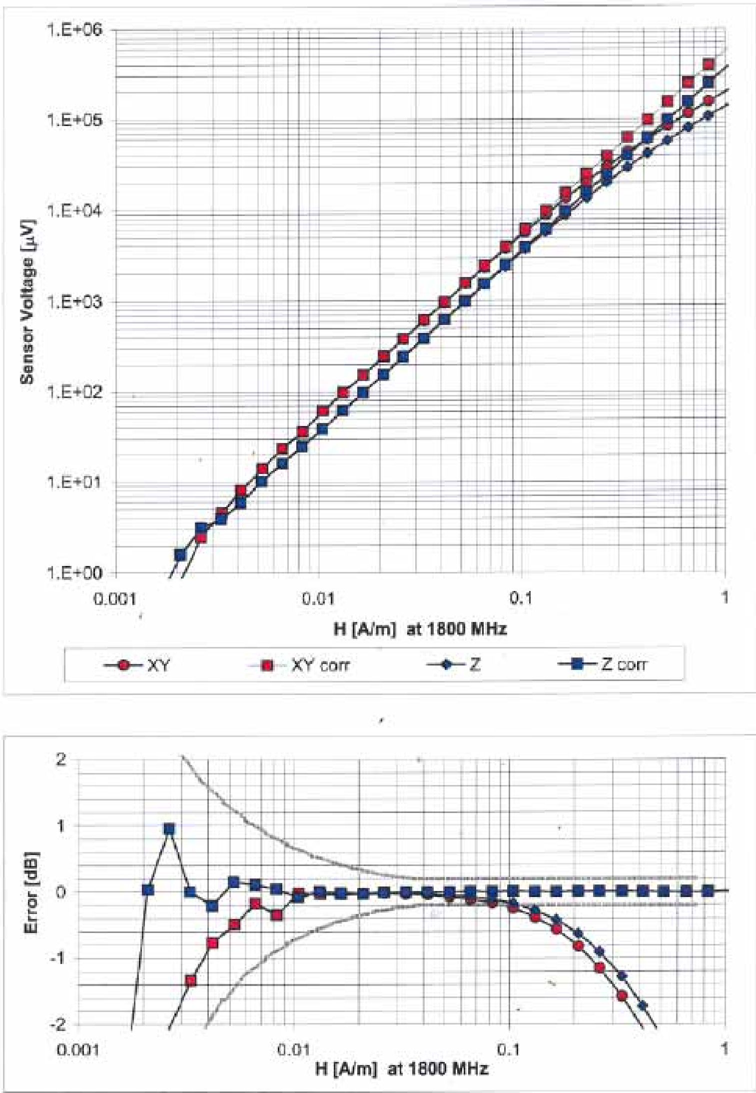
H3DV6 SN:6184 January 28, 2008

Dynamic Range f(H-field)

(Waveguide R22, f = 1800 MHz)



Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Certificate No: H3-6184_Jan08 Page 8 of 8

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Sporton (Auden)**

Certificate No: **CD835V3-1045_Sep07**

CALIBRATION CERTIFICATE

Object	CD835V3 - SN: 1045
Calibration procedure(s)	QA CAL-20.v4 Calibration procedure for dipoles in air
Calibration date:	September 25, 2007
Condition of the calibrated item	In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	03-Oct-06 (METAS, No. 217-00608)	Oct-07
Power sensor HP 8481A	US37292783	03-Oct-06 (METAS, No. 217-00608)	Oct-07
Probe ER3DV6	SN: 2336	27-Dec-06 (SPEAG, No. ER3-2336_Dec06)	Dec-07
Probe H3DV6	SN: 6065	27-Dec-06 (SPEAG, No. H3-6065-Dec06)	Dec-07
DAE4	SN: 903	19-Sep-07 (SPEAG, No. DAE4-903_Sep07)	Sep-08
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Power meter EPM-4419B	GB42420191	11-May-05 (SPEAG, in house check Nov-06)	In house check: Nov-07
Power sensor HP 8482A	US37295597	11-May-05 (SPEAG, in house check Nov-06)	In house check: Nov-07
Power sensor HP 8482H	3318A09450	08-Jan-02 (SPEAG, in house check Nov-06)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07
RF generator E4433B	MY 41310391	22-Nov-04 (SCV, TRS 001-021-0354)	In house check: Nov-07

	Name	Function	Signature
Calibrated by:	Mike Meili	Laboratory Technician	M. Meili
Approved by:	Fin Bomholt	Technical Director	F. Bomholt

Issued: September 27, 2007

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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

References

[1] ANSI-C63.19-2006
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

Methods Applied and Interpretation of Parameters:

- *Coordinate System:* y-axis is in the direction of the dipole arms. z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with standard [1], the measurement planes (probe sensor center) are selected to be at a distance of 10 mm above the top edge of the dipole arms.
- *Measurement Conditions:* Further details are available from the hardcopies at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. The forward power to the dipole connector is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a directional coupler. While the dipole under test is connected, the forward power is adjusted to the same level.
- *Antenna Positioning:* The dipole is mounted on a HAC Test Arch phantom using the matching dipole positioner with the arms horizontal and the feeding cable coming from the floor. The measurements are performed in a shielded room with absorbers around the setup to reduce the reflections.
It is verified before the mounting of the dipole under the Test Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dielectric reference wire and able to move elastically in vertical direction without changing its relative position to the top center of the Test Arch phantom. The vertical distance to the probe is adjusted after dipole mounting with a DASY4 Surface Check job. Before the measurement, the distance between phantom surface and probe tip is verified. The proper measurement distance is selected by choosing the matching section of the HAC Test Arch phantom with the proper device reference point (upper surface of the dipole) and the matching grid reference point (tip of the probe) considering the probe sensor offset. The vertical distance to the probe is essential for the accuracy.
- *Feed Point Impedance and Return Loss:* These parameters are measured using a HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminating by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- *E- field distribution:* E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 10 mm (in z) above the top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms are perfectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-parallelity to the measurement plane as well as the sensor displacement. The E-field value stated as calibration value represents the maximum of the interpolated 3D-E-field, 10mm above the dipole surface.
- *H-field distribution:* H-field is measured with an isotropic H-field probe with 100mW forward power to the antenna feed point, in the x-y-plane. The scan area and sensor distance is equivalent to the E-field scan. The maximum of the field is available at the center (subgrid 5) above the feed point. The H-field value stated as calibration value represents the maximum of the interpolated H-field, 10mm above the dipole surface at the feed point.

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1 Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY4	V4.7 B55
DASY PP Version	SEMCAD	V1.8 B176
Phantom	HAC Test Arch	SD HAC P01 BA, #1070
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 180 mm
Frequency	**835 MHz** ± 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	**interpolated maximum**
Maximum measured	100 mW forward power	**0.453 A/m**

Uncertainty for H-field measurement: 8.2% (k=2)

E-field 10 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured above high end	100 mW forward power	168.2 V/m
Maximum measured above low end	100 mW forward power	165.9 V/m
Averaged maximum above arm	100 mW forward power	**167.1 V/m**

Uncertainty for E-field measurement: 12.8% (k=2)

3 Appendix

3.1 Antenna Parameters

Frequency	**Return Loss**	**Impedance**
800 MHz	15.4 dB	(41.9 – j13.5) Ohm
835 MHz	**30.8 dB**	**(49.7 + j2.8) Ohm**
900 MHz	17.1 dB	(55.1 – j13.9) Ohm
950 MHz	18.9 dB	(48.6 + j11.1) Ohm
960 MHz	15.0 dB	(54.9 + j18.3) Ohm

3.2 Antenna Design and Handling

The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.
Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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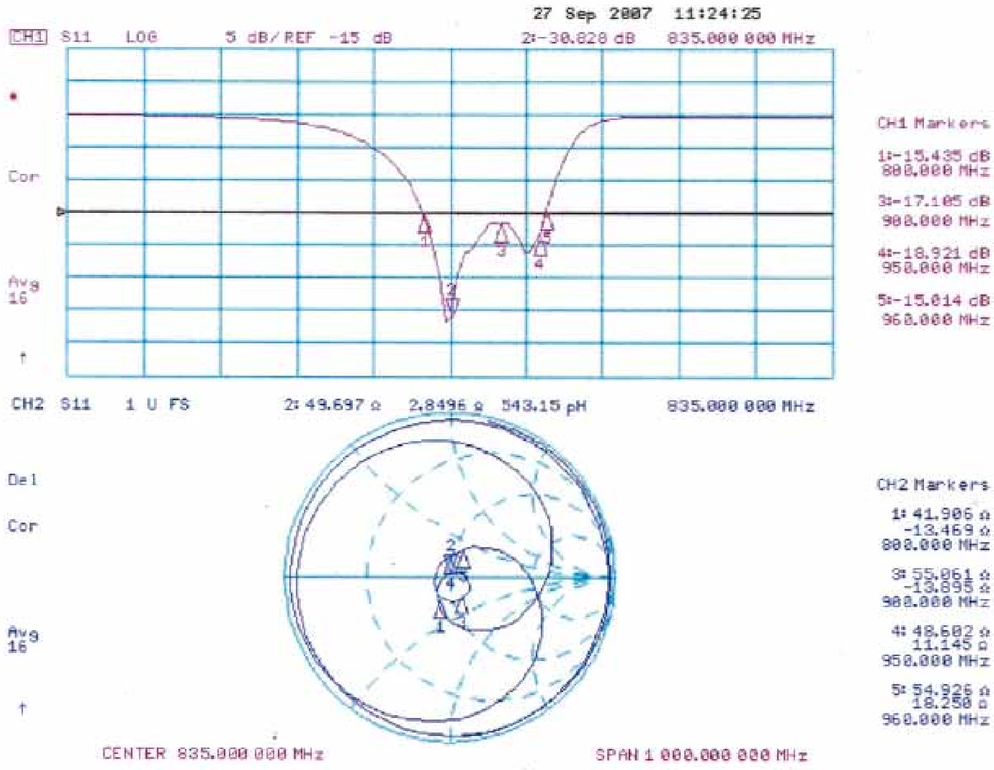
3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



Certificate No: CD835V3-1045_Sep07 Page 4 of 6

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3.3.2 DASY4 H-field result

Date/Time: 25.09.2007 13:54:05

Test Laboratory: SPEAG Lab 2

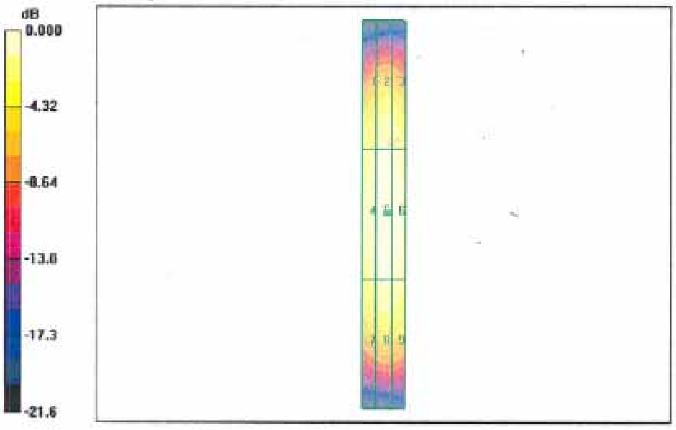
DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: 1045
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: H Dipole Section
Measurement Standard: DASY4 (High Precision Assessment)
DASY4 Configuration:

- Probe: H3DV6 - SN6065; Calibrated: 27.12.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn903; Calibrated: 19.09.2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

H Scan - Sensor Center 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.453 A/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 354.7 mm
Reference Value = 0.477 A/m; Power Drift = 0.000 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.364** **M4**	Grid 2 **0.405** **M4**	Grid 3 **0.396** **M4**
Grid 4 **0.411** **M4**	Grid 5 **0.453** **M4**	Grid 6 **0.444** **M4**
Grid 7 **0.362** **M4**	Grid 8 **0.398** **M4**	Grid 9 **0.391** **M4**



0 dB = 0.453A/m

Certificate No: CD835V3-1045_Sep07   Page 5 of 6

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3.3.3 DASY4 E-Field result

Date/Time: 25.09.2007 11:58:13

Test Laboratory: SPEAG Lab 2

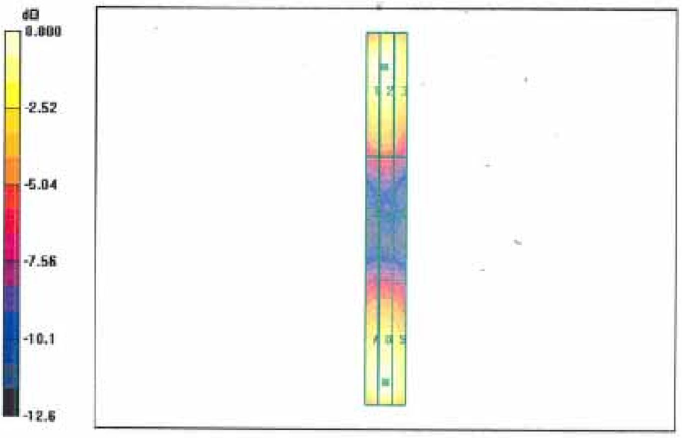
DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1045
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Dipole Section
Measurement Standard: DASY4 (High Precision Assessment)
DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 27.12.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn903; Calibrated: 31.08.2006
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

E Scan - Sensor Center 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 168.2 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 354.7 mm
Reference Value = 109.0 V/m; Power Drift = -0.007 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **164.2** **M4**	Grid 2 **165.9** **M4**	Grid 3 **157.1** **M4**
Grid 4 **87.2** **M4**	Grid 5 **88.4** **M4**	Grid 6 **84.0** **M4**
Grid 7 **163.2** **M4**	Grid 8 **168.2** **M4**	Grid 9 **161.1** **M4**



0 dB = 168.2V/m

Certificate No: CD835V3-1045_Sep07 Page 6 of 6

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Accreditation No.: **SCS 108**

Client **Sporton (Auden)**

Certificate No: **CD1880V3-1038_Sep07**

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1038
Calibration procedure(s)	QA CAL-20.v4 Calibration procedure for dipoles in air
Calibration date:	September 27, 2007
Condition of the calibrated item	In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	03-Oct-06 (METAS, No. 217-00608)	Oct-07
Power sensor HP 8481A	US37292783	03-Oct-06 (METAS, No. 217-00608)	Oct-07
Probe ER3DV6	SN: 2336	27-Dec-06 (SPEAG, No. ER3-2336_Dec06)	Dec-07
Probe H3DV6	SN: 6065	27-Dec-06 (SPEAG, No. H3-6065-Dec06)	Dec-07
DAE4	SN: 903	19-Sep-07 (SPEAG, No. DAE4-903_Sep07)	Sep-08

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-4419B	GB42420191	11-May-05 (SPEAG, in house check Nov-06)	In house check: Nov-07
Power sensor HP 8482A	US37295597	11-May-05 (SPEAG, in house check Nov-06)	In house check: Nov-07
Power sensor HP 8482H	3318A09450	08-Jan-02 (SPEAG, in house check Nov-06)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07
RF generator E4433B	MY 41310391	22-Nov-04 (SCV, TRS 001-021-0354)	In house check: Nov-07

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Fin Bomholt	Technical Director	

Issued: September 28, 2007

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Accreditation No.: **SCS 108**

References

[1] ANSI-C63.19-2006
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

Methods Applied and Interpretation of Parameters:

- *Coordinate System:* y-axis is in the direction of the dipole arms. z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with standard [1], the measurement planes (probe sensor center) are selected to be at a distance of 10 mm above the top edge of the dipole arms.
- *Measurement Conditions:* Further details are available from the hardcopies at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. The forward power to the dipole connector is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a directional coupler. While the dipole under test is connected, the forward power is adjusted to the same level.
- *Antenna Positioning:* The dipole is mounted on a HAC Test Arch phantom using the matching dipole positioner with the arms horizontal and the feeding cable coming from the floor. The measurements are performed in a shielded room with absorbers around the setup to reduce the reflections.
It is verified before the mounting of the dipole under the Test Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dielectric reference wire and able to move elastically in vertical direction without changing its relative position to the top center of the Test Arch phantom. The vertical distance to the probe is adjusted after dipole mounting with a DASY4 Surface Check job. Before the measurement, the distance between phantom surface and probe tip is verified. The proper measurement distance is selected by choosing the matching section of the HAC Test Arch phantom with the proper device reference point (upper surface of the dipole) and the matching grid reference point (tip of the probe) considering the probe sensor offset. The vertical distance to the probe is essential for the accuracy.
- *Feed Point Impedance and Return Loss:* These parameters are measured using a HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminating by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- *E- field distribution:* E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 10 mm (in z) above the top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms are perfectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-parallelity to the measurement plane as well as the sensor displacement. The E-field value stated as calibration value represents the maximum of the interpolated 3D-E-field, 10mm above the dipole surface.
- *H-field distribution:* H-field is measured with an isotropic H-field probe with 100mW forward power to the antenna feed point, in the x-y-plane. The scan area and sensor distance is equivalent to the E-field scan. The maximum of the field is available at the center (subgrid 5) above the feed point. The H-field value stated as calibration value represents the maximum of the interpolated H-field, 10mm above the dipole surface at the feed point.

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1 Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY4	V4.7 B55
DASY PP Version	SEMCAD	V1.8 B176
Phantom	HAC Test Arch	SD HAC P01 BA, #1002
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 90 mm
Frequency	**1880 MHz** ± 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured	100 mW forward power	**0.471 A/m**

Uncertainty for H-field measurement: 8.2% (k=2)

E-field 10 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured above high end	100 mW forward power	138.9 V/m
Maximum measured above low end	100 mW forward power	138.8 V/m
Averaged maximum above arm	100 mW forward power	**138.9 V/m**

Uncertainty for E-field measurement: 12.8% (k=2)

3 Appendix

3.1 Antenna Parameters

Frequency	**Return Loss**	**Impedance**
1710 MHz	19.2 dB	(48.9 + j10.9) Ohm
1880 MHz	**22.1 dB**	**(53.8 + j7.2) Ohm**
1900 MHz	22.1 dB	(56.5 + j5.2) Ohm
1950 MHz	26.1 dB	(54.3 – j2.9) Ohm
2000 MHz	19.1 dB	(40.1 + j0.4) Ohm

3.2 Antenna Design and Handling

The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.

The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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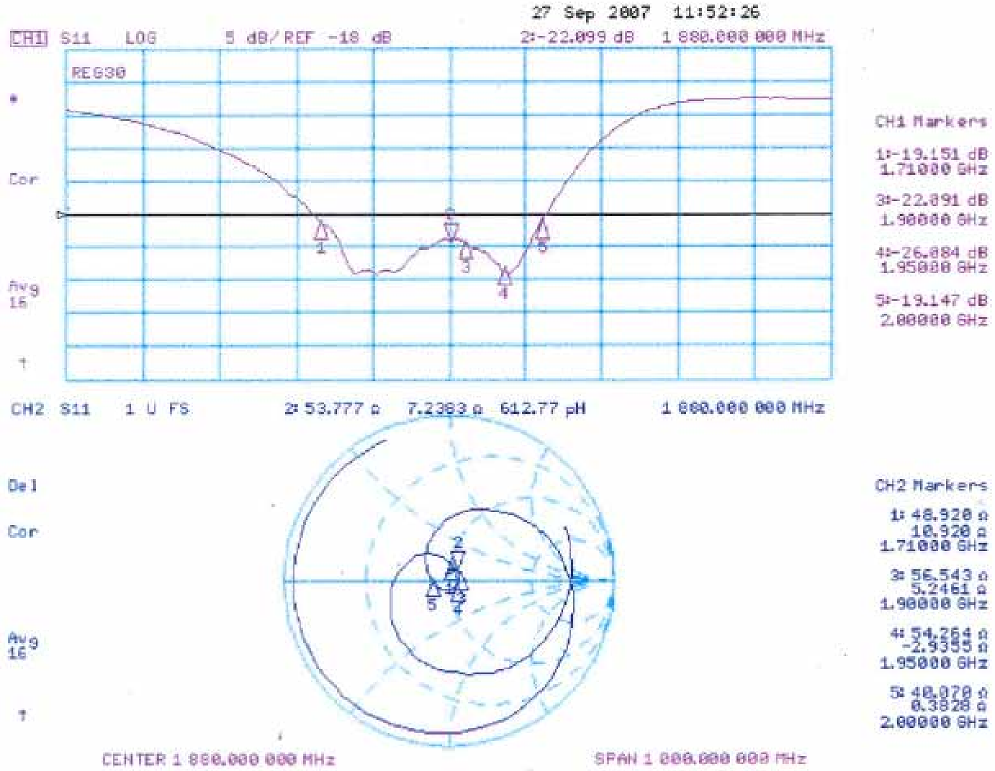
3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



Certificate No: CD1880V3-1038_Sep07 Page 4 of 6

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3.3.2 DASY4 H-Field Result

Date/Time: 25.09.2007 15:53:23

Test Laboratory: SPEAG Lab 2

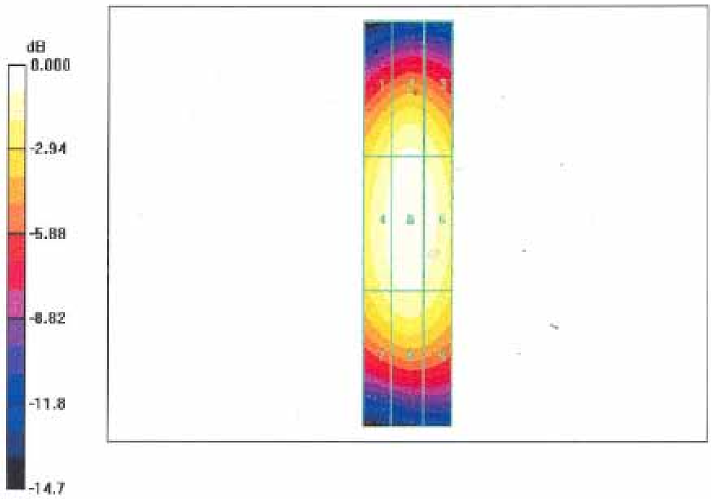
DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1038
Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: H Dipole Section
Measurement Standard: DASY4 (High Precision Assessment)
DASY4 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 27.12.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn903; Calibrated: 19.09.2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

H Scan - Sensor Center 10mm above CD1880V3 Dipole/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.471 A/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 354.7 mm
Reference Value = 0.498 A/m; Power Drift = 0.009 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.404 M2**	Grid 2 **0.435 M2**	Grid 3 **0.418 M2**
Grid 4 **0.442 M2**	Grid 5 **0.471 M2**	Grid 6 **0.454 M2**
Grid 7 **0.402 M2**	Grid 8 **0.426 M2**	Grid 9 **0.410 M2**



0 dB = 0.471A/m

Certificate No: CD1880V3-1038_Sep07 Page 5 of 6

3.3.3 DASY4 E-Field Result

Date/Time: 27.09.2007 12:27:44

Test Laboratory: SPEAG Lab 2

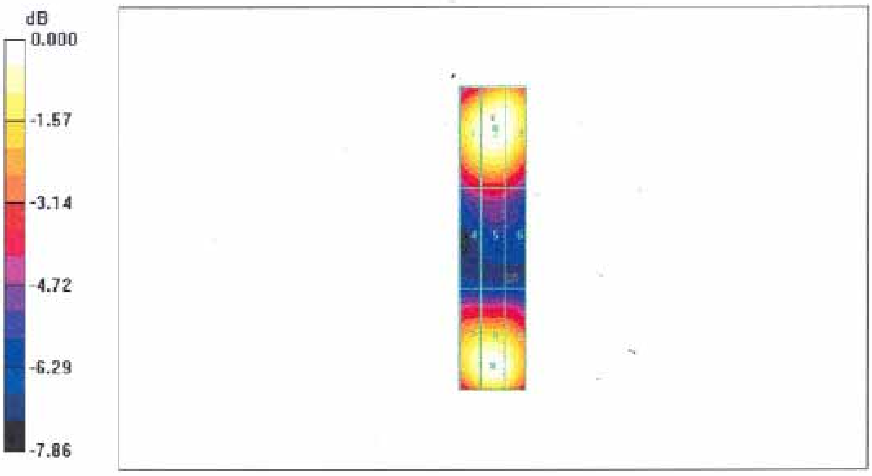
DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1038
Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Dipole Section
Measurement Standard: DASY4 (High Precision Assessment)
DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 27.12.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn903; Calibrated: 19.09.2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 174

E Scan - Sensor Center 10mm above CD1880V3 Dipole/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 138.9 V/m
Probe Modulation Factor = 1.00
Reference Value = 156.3 V/m; Power Drift = 0.002 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 133.8 M2	Grid 2 138.9 M2	Grid 3 137.0 M2
Grid 4 89.9 M3	Grid 5 92.3 M3	Grid 6 89.1 M3
Grid 7 133.4 M2	Grid 8 138.8 M2	Grid 9 133.8 M2



0 dB = 138.9V/m

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Accreditation No.: **SCS 108**

Client **Sporton (Auden)**

Certificate No: **DAE3-577_Nov07**

CALIBRATION CERTIFICATE

Object	DAE3 - SD 000 D03 AA - SN: 577
Calibration procedure(s)	QA CAL-06.v12 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	November 16, 2007
Condition of the calibrated item	In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Fluke Process Calibrator Type 702	SN: 6295803	04-Oct-07 (Elcal AG, No: 6467)	Oct-08
Keithley Multimeter Type 2001	SN: 0810278	03-Oct-07 (Elcal AG, No: 6465)	Oct-08
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Calibrator Box V1.1	SE UMS 006 AB 1004	25-Jun-07 (SPEAG, in house check)	In house check Jun-08

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	D. Steffen
Approved by:	Fin Bomholt	R&D Director	i.V.

Issued: November 16, 2007

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Accreditation No.: **SCS 108**

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

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DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.432 ± 0.1% (k=2)	403.884 ± 0.1% (k=2)	404.331 ± 0.1% (k=2)
Low Range	3.94218 ± 0.7% (k=2)	3.94771 ± 0.7% (k=2)	3.94526 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	268 ° ± 1 °

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Appendix

1. DC Voltage Linearity

High Range		Input (µV)	Reading (µV)	Error (%)
Channel X	+ Input	200000	199999.3	0.00
Channel X	+ Input	20000	20005.75	0.03
Channel X	- Input	20000	-19997.67	-0.01
Channel Y	+ Input	200000	199999.5	0.00
Channel Y	+ Input	20000	20002.82	0.01
Channel Y	- Input	20000	-20004.40	0.02
Channel Z	+ Input	200000	199999.6	0.00
Channel Z	+ Input	20000	20005.54	0.03
Channel Z	- Input	20000	-20001.11	0.01

Low Range		Input (µV)	Reading (µV)	Error (%)
Channel X	+ Input	2000	2000.1	0.00
Channel X	+ Input	200	199.12	-0.44
Channel X	- Input	200	-200.64	0.32
Channel Y	+ Input	2000	2000	0.00
Channel Y	+ Input	200	199.96	-0.02
Channel Y	- Input	200	-201.00	0.50
Channel Z	+ Input	2000	1999.9	0.00
Channel Z	+ Input	200	199.05	-0.47
Channel Z	- Input	200	-201.08	0.54

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	13.88	12.97
	- 200	-12.40	-14.29
Channel Y	200	-6.32	-6.22
	- 200	5.34	5.31
Channel Z	200	1.08	0.59
	- 200	-1.42	-1.66

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	1.14	0.16
Channel Y	200	1.52	-	3.87
Channel Z	200	0.23	0.75	-

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4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15969	16269
Channel Y	15848	16148
Channel Z	16203	16661

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.12	-1.70	1.72	0.50
Channel Y	-2.46	-3.42	-1.39	0.44
Channel Z	-0.78	-2.16	0.00	0.29

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.2000	199.3
Channel Y	0.2001	199.9
Channel Z	0.1999	199.4

8. Low Battery Alarm Voltage (verified during pre test)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (verified during pre test)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.0	+6	+14
Supply (- Vcc)	−0.01	-8	-9

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Appendix D - CDMA2000 1xRTT Test Modes for HAC

The phone was tested in all normal configurations for the ear usage. These test configurations are tested at the high, middle and low frequency channels of each applicable operating mode, if applicable; each configuration is tested with the antenna in its fully stowed and deployed positions. The signal was setup by linking an over the air connection between the EUT and an Agilent 8960 (E5515C Wireless Communications Tester). The CDMA radio is available on IS-95 (Radio Configuration 1) and CDMA2000 1xRTT (Radio Configuration 3). The EUT supports IS95 2G networks, CDMA2000 1xRTT for Cellular band and PCS band. The maximum peak field is chosen for HAC testing for worst case scenario. A full HAC measurement in this report is done in CDMA2000 1xRTT mode RC1 + SO2 for Cellular band and PCS band.

Peak Field list:

Band	RC	SO	Type	Data Rate	Peak Field (A/m)
					Mid Ch (600)
CDMA2000 PCS (1xRTT)	**1**	**2**	**Loop**	Full	0.173
				Eighth	**0.204**
	1	3	Voice	-	0.197
	1	55	Loop	Full	0.174
				Eighth	0.2
	2	17	Voice	-	0.197
	2	32768	Voice	-	0.197
	3	55	Loop	Full	0.172
	3	2	Loop	Full	0.174

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Power list:

CDMA2000 Cellular	RC	SO	Type	Data Rate	Conducted Power (dBm)	Conducted Power (dBm)	Conducted Power (dBm)
					Low Ch (1013)	Mid Ch (384)	High Ch (777)
CDMA 1xRTT	1	2	Loop	Full	23.81	23.78	23.73
				Eighth	23.77	23.75	23.67
	1	3	Voice	-	23.79	23.80	23.75
	1	55	Loop	Full	23.78	23.79	23.74
				Eighth	23.80	23.78	23.70
	2	17	Voice	-	23.78	23.78	23.73
	2	32768	Voice	-	23.82	23.81	23.76
	3	2	Loop	Full	23.80	23.77	23.73
				Eighth	x	x	x
	3	3	Voice	-	x	x	x
	3	55	Loop	Full	23.82	23.79	23.75
				Eighth	x	x	x
	4	3	Voice	-	x	x	x
	5	17	Voice	-	x	x	x
	5	32768	Voice	-	x	x	x

Remark: “x” = not supported

CDMA2000 PCS	RC	SO	Type	Data Rate	Conducted Power (dBm)	Conducted Power (dBm)	Conducted Power (dBm)
					Low Ch (25)	Mid Ch (600)	High Ch (1175)
CDMA 1xRTT	1	2	Loop	Full	23.35	23.55	23.45
				Eighth	23.38	23.58	23.48
	1	3	Voice	-	23.33	23.62	23.50
	1	55	Loop	Full	23.33	23.54	23.47
				Eighth	23.38	23.59	23.49
	2	17	Voice	-	23.33	23.61	23.50
	2	32768	Voice	-	23.35	23.63	23.51
	3	2	Loop	Full	23.36	23.56	23.50
				Eighth	x	x	x
	3	3	Voice	-	x	x	x
	3	55	Loop	Full	23.42	23.59	23.51
				Eighth	x	x	x
	4	3	Voice	-	x	x	x
	5	17	Voice	-	x	x	x
	5	32768	Voice	-	x	x	x

Remark: “x” = not supported

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