Hearing Aid Compatibility (HAC) Test Report

for

Palm, Inc.

on the

PDA Phone

Report No.	:	HA741601
Trade Name	:	palm
Model Name	:	Treo 800w
FCC ID	:	O8F-715
IC ID	:	3905A-715
Date of Testing	:	Feb. 28, 2007
Date of Report	:	Jun. 20, 2007
Date of Review	:	Jun. 20, 2007

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- Report Version: Rev.01

SPORTON International Inc.

No. 52, Hea Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Uuan Hsien Taiwn, R.O.C.

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1. Statement of Compliance

The Hearing Aid Compliance (HAC) maximum results found during testing for the **Palm, Inc. PDA Phone palm Treo 800w** are as follows (with expanded uncertainly ±29.4% for E-field and ±21.8% for H-field)**:**

	E-Field (V/m)	M Rating	H-Field (A/m)	M Rating
CDMA2000 850 Band	99.3	M4	0.222	M4
CDMA2000 1900 Band	60.5	M4	0.179	M4

They are in compliance with HAC limits specified in guidelines FCC 47CFR §20.19 and ANSI Standard ANSI PC 63.19 for HAC Rated category M3.

This device meets M4 rating.

Approved by

Roy Wu
Deputy Manager

2. Administration Data

2.1 Testing Laboratory

Company Name :	Sporton International Inc.
Department :	Antenna Design/SAR
Address :	No.52, Hwa-Ya 1st RD., Hwa Ya Technology Park, Kwei-Shan Hsiang, TaoYuan Hsien, Taiwan, R.O.C.
Telephone Number :	886-3-327-3456
Fax Number :	886-3-327-0973

2.2 Detail of Applicant

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

2.3 Detail of Manufacturer

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

2.4 Application Detail

Date of reception of application:	Feb. 28, 2007
Start of test :	Feb. 28, 2007
End of test :	Feb. 28, 2007

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3. General Information

3.1 Description of Device Under Test (DUT)

DUT Type :	PDA Phone
Trade Name :	palm
Model Name :	Treo 800w
FCC ID :	O8F-715
IC ID :	3905A-715
Tx Frequency :	850 Band : 824-849 1900 Band : 1850-1910
Rx Frequency :	850 Band : 869-894 1900 Band : 1930-1990
Antenna Type :	Fixed Internal
Maximum Output Power to Antenna :	**CDMA2000 Cellular 850 (1xRTT)** FCH_RC1 : 24.07 dBm **CDMA2000 PCS1900 (1xRTT)** FCH_RC1 : 25.84 dBm
Type of Modulation :	QPSK
DUT Stage :	DVT
Application Type :	Certification

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3.2 Applied Standards:

The ANSI Standard ANSI PC 63.19 revision draft 3.12 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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3.4 Test Conditions:

3.4.1 Ambient Condition

Ambient Temperature (°C)	20-24°C
Humidity (%)	<60 %

3.4.2 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 testings.

During RF HAC testing, BT or WiFi were turned off.

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

4. Hearing Aid Compliance (HAC)

4.1 Introduction

The federal communication commission (FCC) adopted ANSI PC 63.19 as HAC test standard.

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5. HAC Measurement Setup

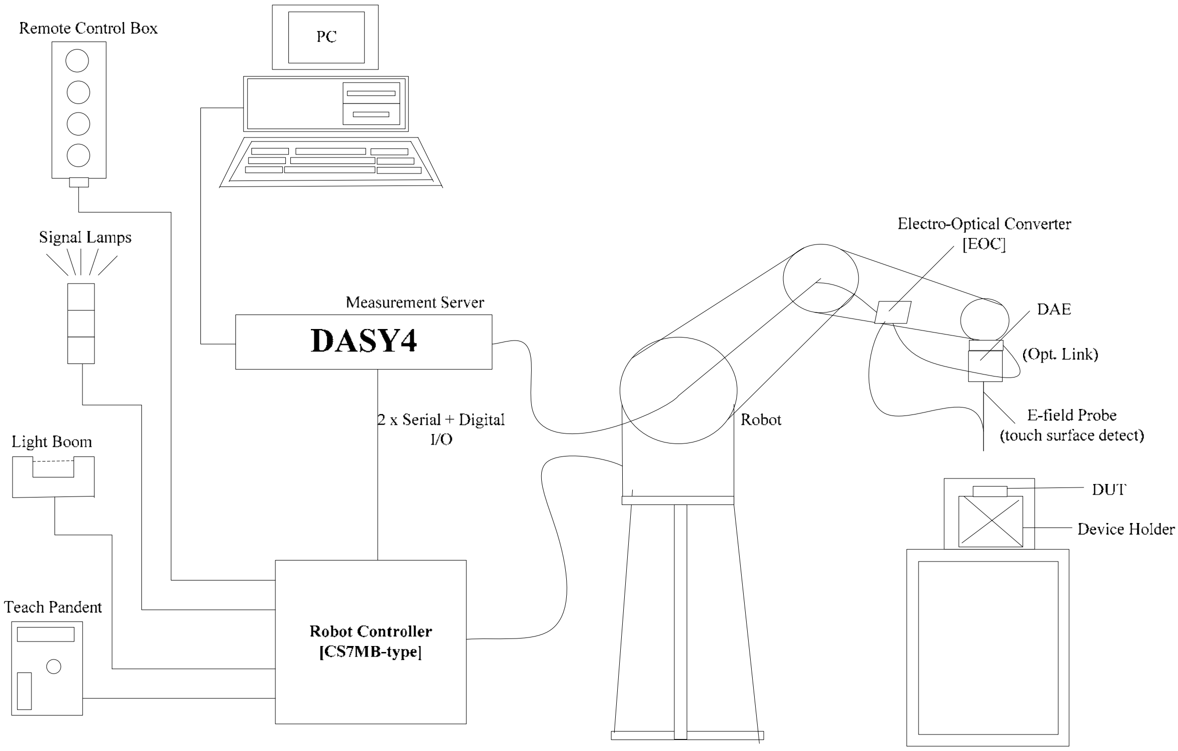

Fig. 5.1 DASY4 system

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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.

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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

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:

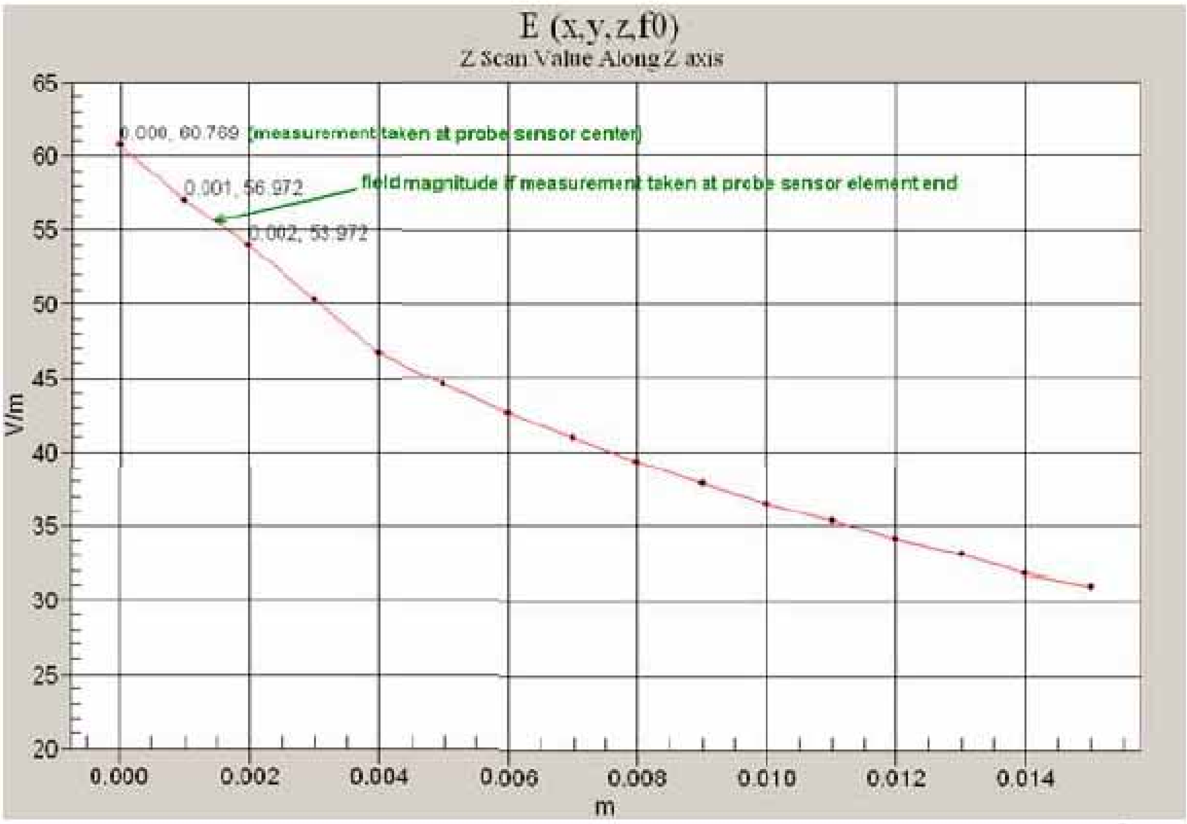

Fig. 5.4 Z-Axis Scan at maximum point above a typical wireless device for E-field

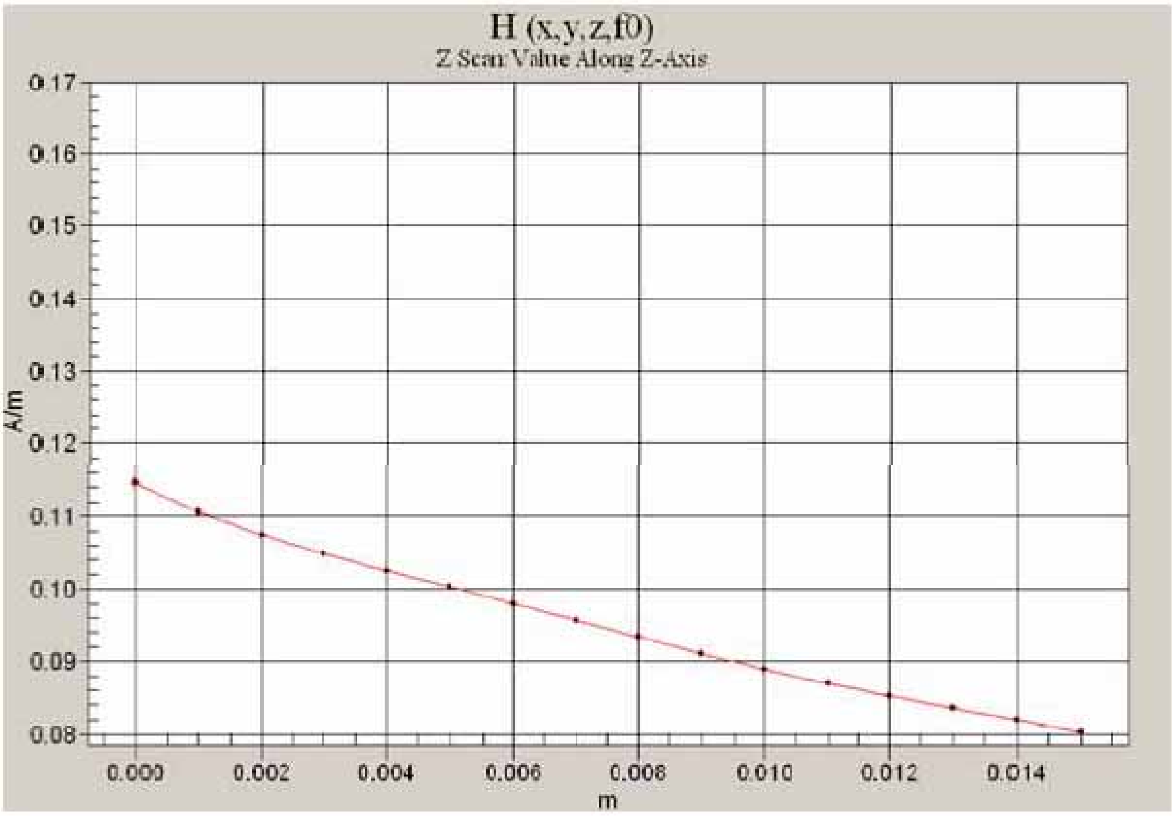

Fig. 5.5 Z-Axis Scan at maximum point above a typical wireless device for H-field

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 (DAE4) 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 DAE4 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 DASYS 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.

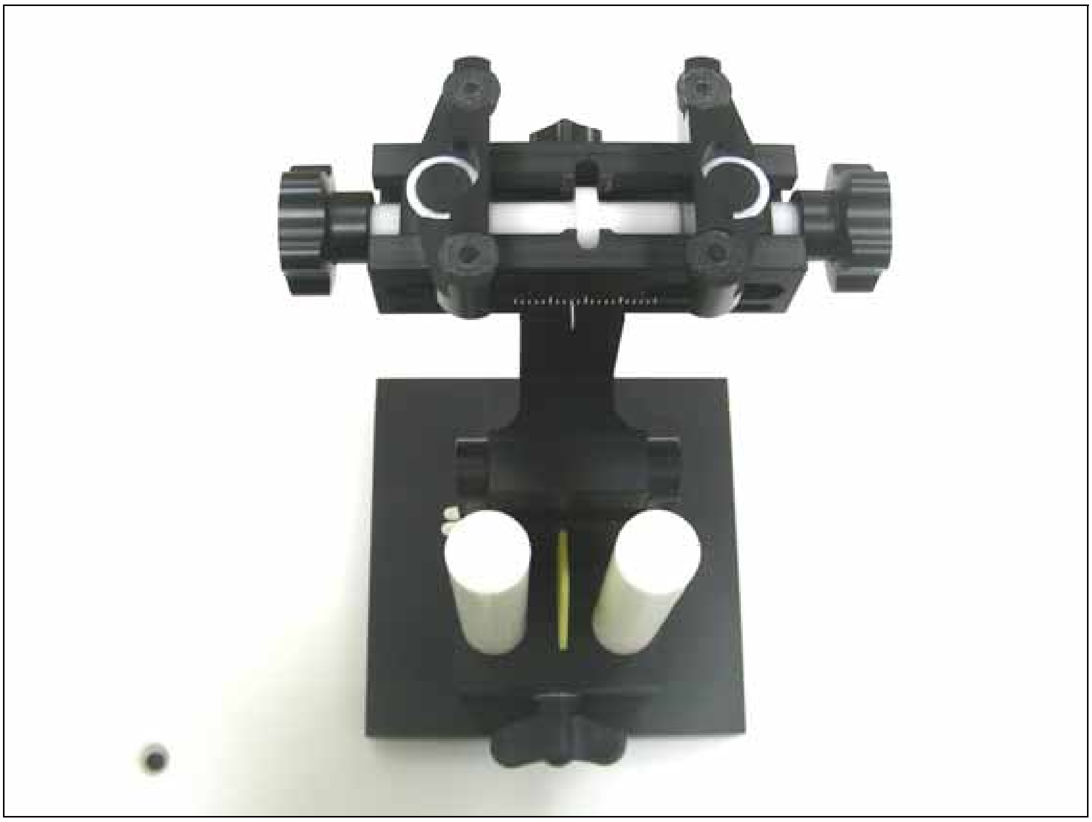

Fig. 5.6 Phone Positioner

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

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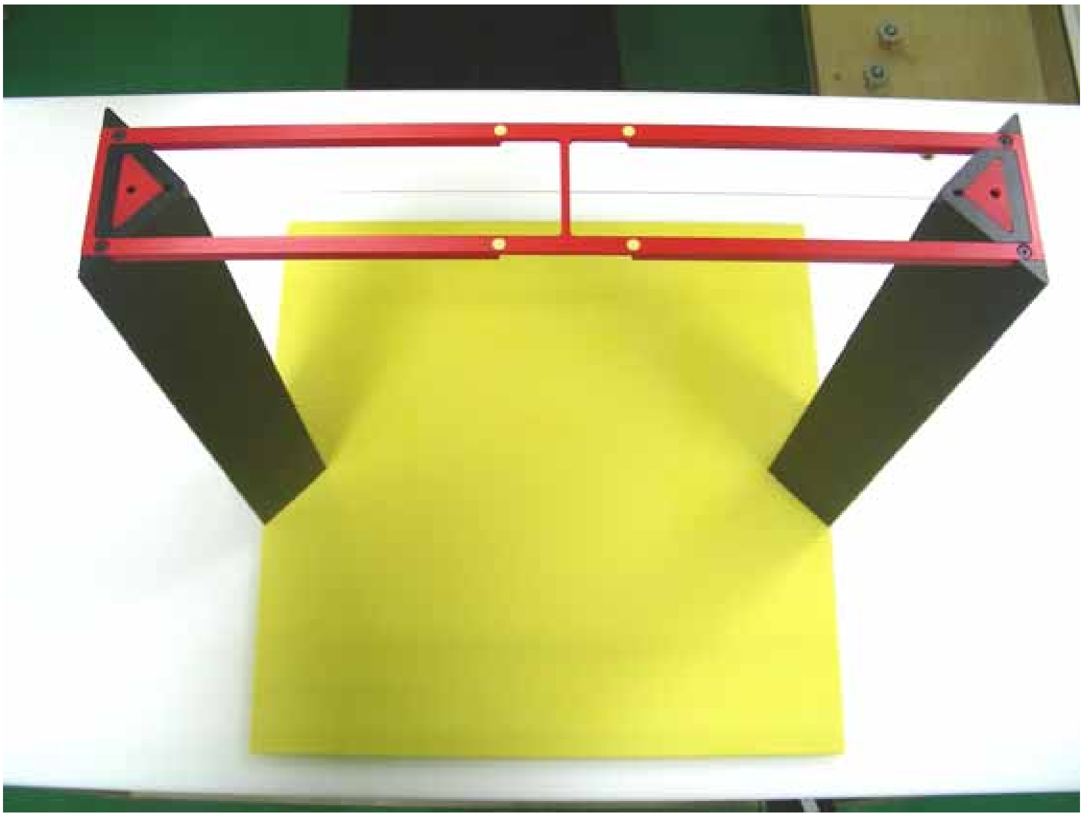

Fig. 5.7 Test Arch Phantom

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 postprocessing 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 postprocessing 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 multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as：

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

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)

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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%.

5.8 Test Equipment List

Manufacture	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Isotropic E-Filed Probe	ER3DV6	2358	Feb. 21, 2007	Feb. 21, 2008
SPEAG	Isotropic H-Filed Probe	H3DV6	6184	Feb. 21, 2007	Feb. 21, 2008
SPEAG	835MHz Calibration Dipole	CD835V3	1045	Sep. 15, 2005	Sep. 15, 2007
SPEAG	1880MHz Calibration Dipole	CD1880V3	1038	Sep. 13, 2005	Sep. 13, 2007
SPEAG	2450MHz Calibration Dipole	CD2450V3	1039	Sep. 08, 2005	Sep. 08, 2007
SPEAG	Data Acquisition Electronics	DAE3	577	Nov. 21, 2006	Nov. 21, 2007
SPEAG	Phone Positoiner	N/A	N/A	NCR	NCR
SPEAG	Test Arch Phantom	N/A	N/A	NCR	NCR
SPEAG	Phantom	QD 000 P40 C	TP-1150	NCR	NCR
SPEAG	Robot	Staubli RX90BL	F03/5W15A1/A/01	NCR	NCR
SPEAG	Software	DASY4 V4.6 Build 23	N/A	NCR	NCR
SPEAG	Software	SEMCAD V1.8 Build 161	N/A	NCR	NCR
SPEAG	Measurement Server	SE UMS 001 BA	1021	NCR	NCR
Agilent	ENA series Network Analyzer	E5071B	MY42403579	Feb. 21, 2007	Feb. 21, 2008
Agilent	Dual Directional Coupler	778D	50422	NCR	NCR
Agilent	Power Amplifier	8449B	3008A01917	NCR	NCR
Agilent	Power Meter	E4416A	GB41292344	Feb. 08, 2007	Feb. 08, 2008
Agilent	Power Sensor	E9327A	US40441548	Feb. 08, 2007	Feb. 08, 2008
Agilent	Signal Generator	E8247C	MY43320596	Mar. 01, 2006	Mar. 01, 2008
Agilent	Signal Generator	E4438C	MY45093171	Feb. 17, 2006	Feb. 17, 2008
Agilent	Wireless COM. Test Set	E5515C	GB46311322	Dec. 22, 2006	Dec. 22, 2008

Table 5.6 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

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 DASY

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7. HAC Measurement Evaluation

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY 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:

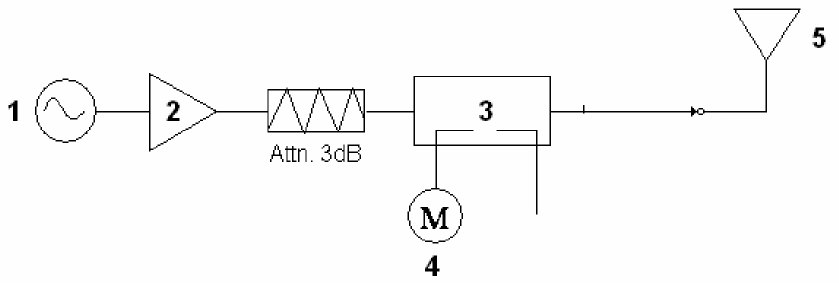

Fig. 7.1

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.

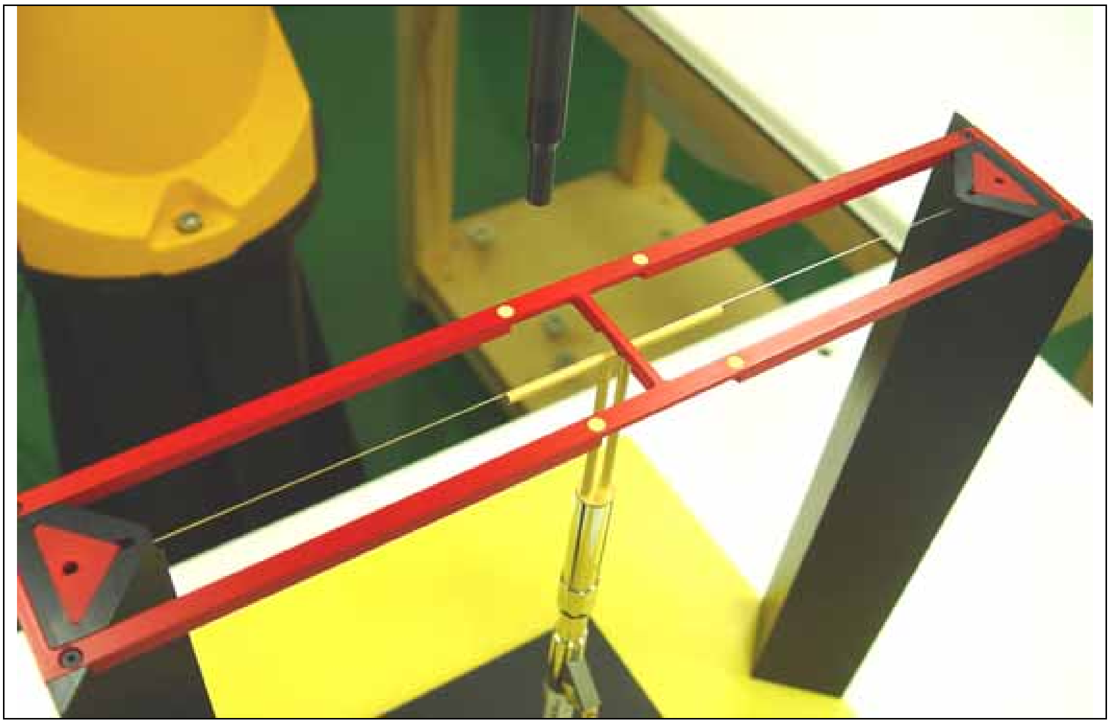

Fig 7.2 Dipole Setup

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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	165.9	162.8	1.9 %
1880	20.0	131.85	133.7	-1.4 %

Frequency (MHz)	Input Power (dBm)	H-field Result (A/m)	Target Field (A/m)	Deviation (%)
835	20.0	0.446	0.453	-1.5 %
1880	20.0	0.435	0.456	-4.6 %

Table 7.1

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%.

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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.

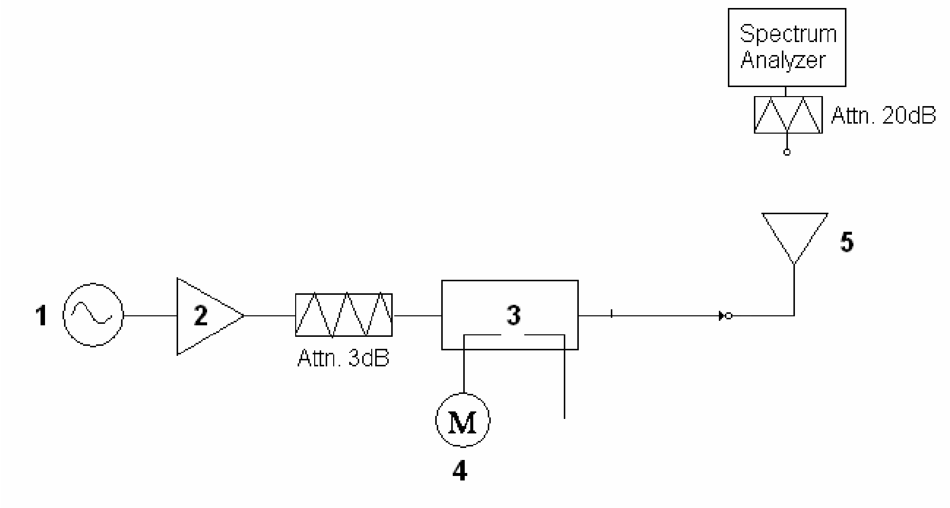

Fig. 8.1

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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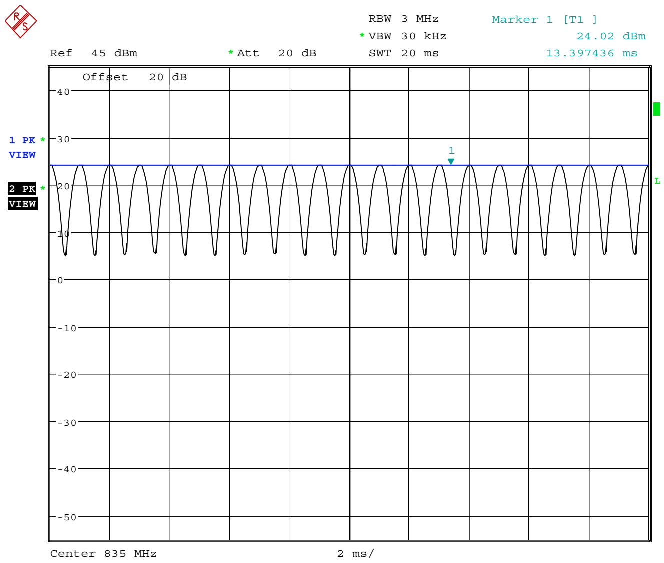
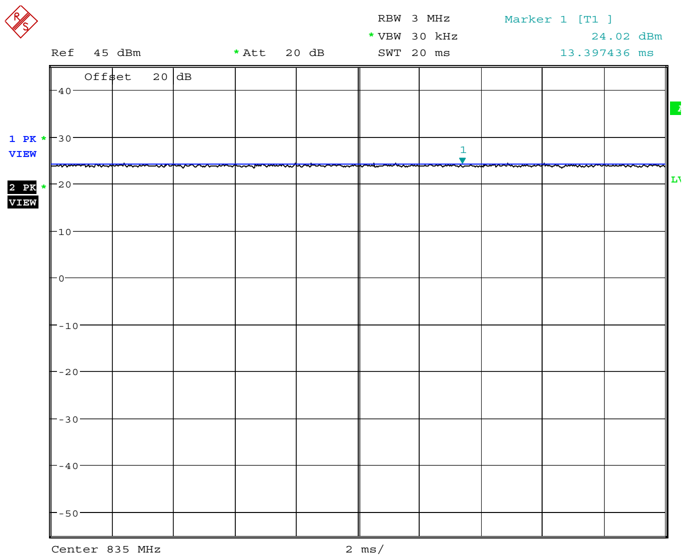
PMF Measurement Summary:

Frequency	Functions	Peak Power	E-field	H-field	PMF	
			V/m	A/m	E-field	H-field
835MHz	CW	24dBm	165.2	0.778		
835MHz	AM	24dBm	106.3	0.490	1.55	1.59
835MHz	CDMA	24dBm	107.3	0.503	0.99	0.97
835MHz	CMDA1/8	24dBm	39.4	0.178	2.72	2.82
1880MHz	CW	25.8dBm	223.4	0.913		
1880MHz	AM	25.8dBm	141.0	0.567	1.58	1.61
1880MHz	CDMA	25.8dBm	139.6	0.579	1.01	0.98
1880MHz	CMDA1/8	25.8dBm	50.2	0.202	2.78	2.86

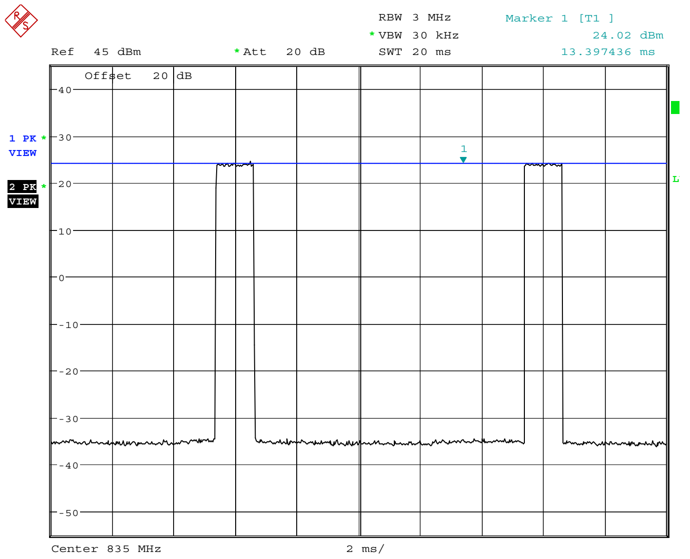
Zero span Spectrum Plots for RF Field Probe Modulation Factor



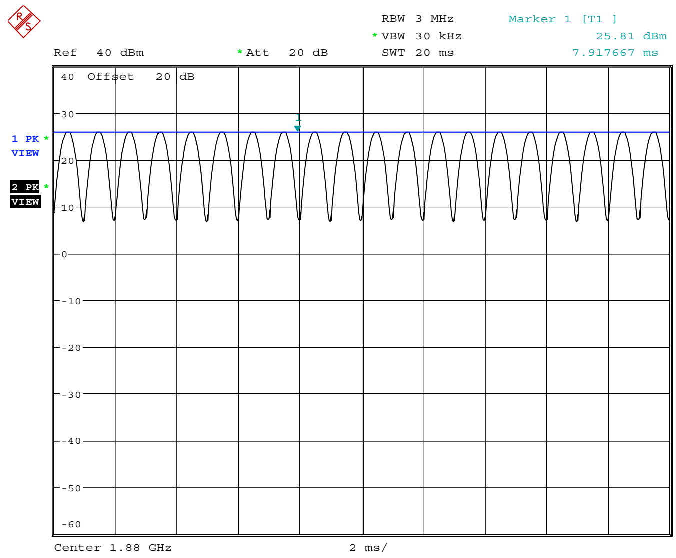
835MHz - CW and 80% AM



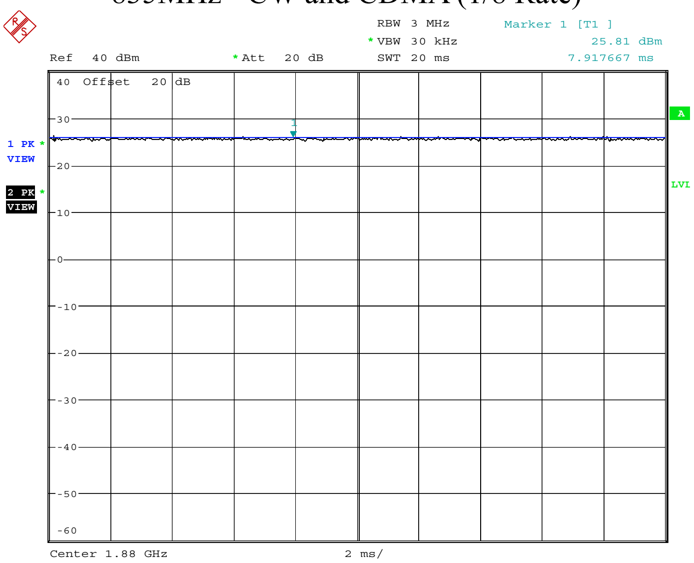
835MHz - CW and CDMA (Full Rate)



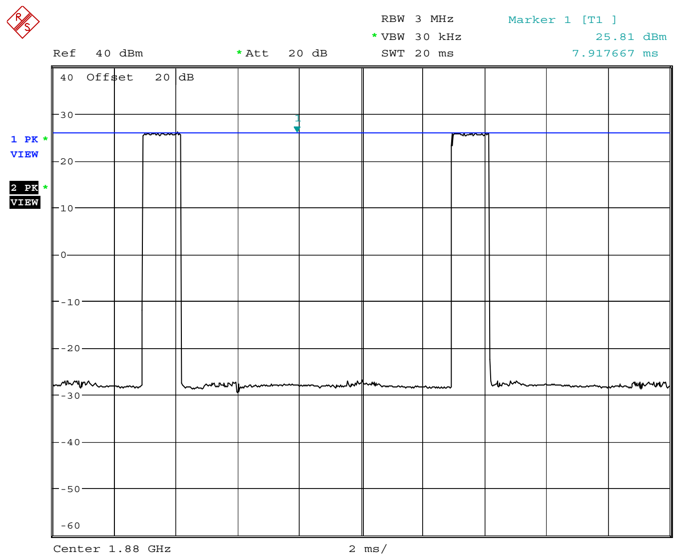
835MHz - CW and CDMA (1/8 Rate)



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.

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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 2 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.

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11. HAC Test Results

11.1 E-Field Emission

Mode	Chan.	Freq. (MHz)	Modulation type	PMF	Conducted Power (dBm)	Power Drift (dB)	Peak Field (V/m)	Result
CDMA2000 850 Band FCH+RC1	1013	827.70	QPSK	0.99	23.77	0.023	72.5	M4
	384	832.56	QPSK	0.99	24.07	0.137	87.1	M4
	777	**848.31**	**QPSK**	**0.99**	**23.97**	**-0.141**	**99.3**	**M4**
CDMA2000 1900 Band FCH+RC1	**25**	**1851.25**	**QPSK**	**1.01**	**24.37**	**-0.128**	**60.5**	**M4**
	600	1880.00	QPSK	1.01	23.26	-0.091	52.4	M4
	1175	1908.75	QPSK	1.01	25.84	0.183	51.3	M4

11.2 H-Field Emission

Mode	Chan.	Freq. (MHz)	Modulation type	PMF	Conducted Power (dBm)	Power Drift (dB)	Peak Field (A/m)	Result
CDMA2000 850 Band FCH+RC1	1013	827.70	QPSK	0.97	23.77	-0.086	0.156	M4
	384	832.56	QPSK	0.97	24.07	-0.057	0.199	M4
	777	**848.31**	**QPSK**	**0.97**	**23.97**	**0.153**	**0.222**	**M4**
CDMA2000 1900 Band FCH+RC1	**25**	**1851.25**	**QPSK**	**0.98**	**24.37**	**0.155**	**0.179**	**M4**
	600	1880.00	QPSK	0.98	23.26	0.016	0.139	M4
	1175	1908.75	QPSK	0.98	25.84	-0.084	0.124	M4

Test Engineer：John Tsai

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12. References

[1] ANSI-PC 63.19 D3.12, "American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids", January 10, 2006
[2] DASY4 System Hand book.

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Appendix A - System Performance Check Data

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC_E_Dipole_835MHz_20070228

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 : 20.6 ℃

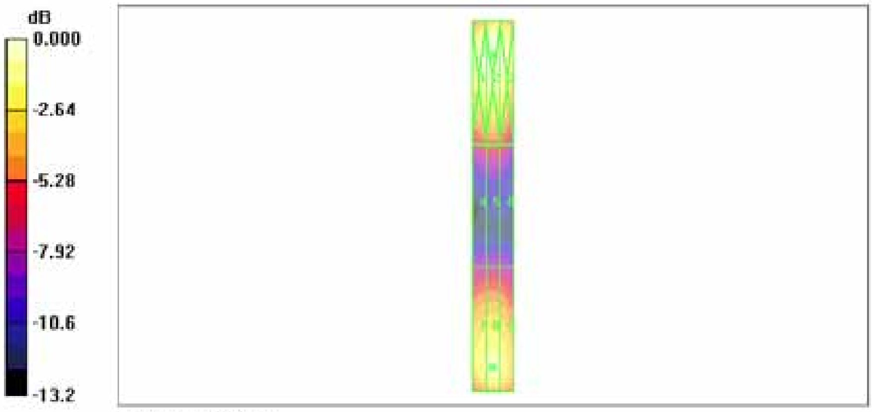
DASY4 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2/21/2007
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

E Scan - ER probe center 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1):
Measurement grid: dx=5mm, dy=5mm

Probe Modulation Factor = 1.00
Reference Value = 105.3 V/m; Power Drift = 0.023 dB

Peak E-field in V/m

Grid 1 **175.2**	Grid 2 **178.5**	Grid 3 **171.1**
Grid 4 **90.9**	Grid 5 **93.5**	Grid 6 **89.7**
Grid 7 **148.4**	Grid 8 **153.3**	Grid 9 **148.3**



0 dB = 178.5V/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC_E_Dipole_1880MHz_20070228

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 : 20.6 ℃

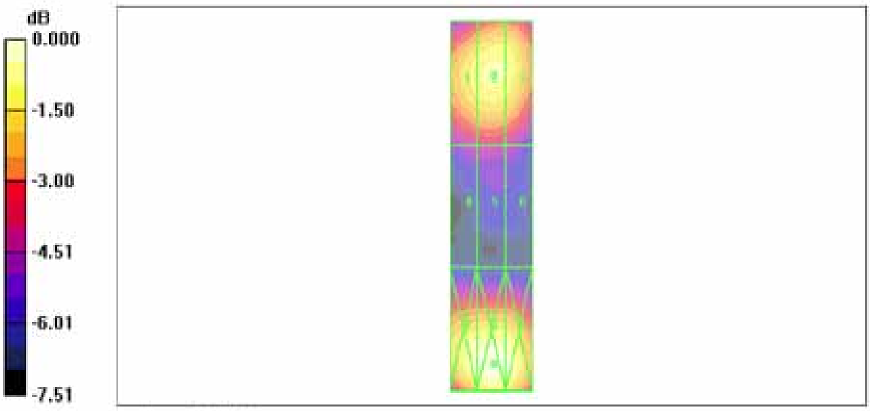
DASY4 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2/21/2007
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

E Scan - ER probe center 10mm above CD1880 Dipole/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm

Probe Modulation Factor = 1.00
Reference Value = 158.1 V/m; Power Drift = 0.015 dB

Peak E-field in V/m

Grid 1 **121.1**	Grid 2 **125.3**	Grid 3 **123.3**
Grid 4 **85.1**	Grid 5 **87.1**	Grid 6 **84.2**
Grid 7 **132.1**	Grid 8 **138.4**	Grid 9 **134.5**



0 dB = 138.4V/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC_H_Dipole_835MHz_20070228

DUT: HAC-Dipole 835 MHz

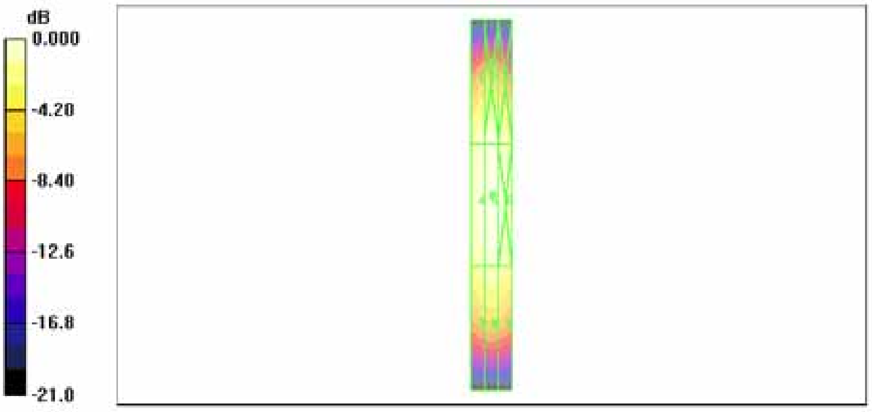
Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Ambient Temperature : 20.5 ℃

DASY4 Configuration:
- Probe: H3DV6 - SN6184; ; Calibrated: 2/21/2007
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

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 = 0.446 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.366 A/m; Power Drift = 0.005 dB

Peak H-field in A/m

Grid 1 **0.383**	Grid 2 **0.404**	Grid 3 **0.387**
Grid 4 **0.421**	Grid 5 **0.446**	Grid 6 **0.429**
Grid 7 **0.357**	Grid 8 **0.374**	Grid 9 **0.360**



0 dB = 0.446A/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC_H_Dipole_1880MHz_20070228

DUT: HAC Dipole 1880 MHz

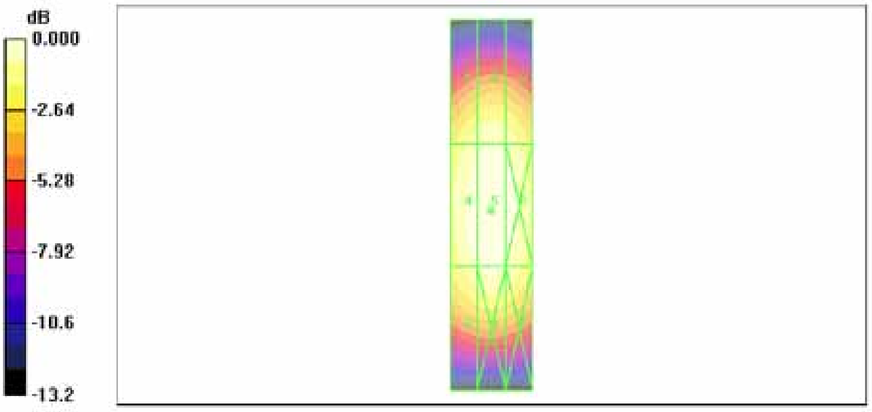
Communication System: CW; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Ambient Temperature : 21.0 ℃

DASY4 Configuration:
- Probe: H3DV6 - SN6184; ; Calibrated: 2/21/2007
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

H Scan - H3DV6 probe center 10mm above CD1880 Dipole/Hearing Aid Compatibility Test (41x181x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.435 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.151 A/m; Power Drift = 0.021 dB

Peak H-field in A/m

Grid 1 **0.377**	Grid 2 **0.394**	Grid 3 **0.380**
Grid 4 **0.413**	Grid 5 **0.435**	Grid 6 **0.419**
Grid 7 **0.388**	Grid 8 **0.404**	Grid 9 **0.390**



0 dB = 0.435A/m

Appendix B - HAC Measurement Data

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC-E_CDMA2000 Ch1013_20070228_FCH-RC1

DUT: 741601

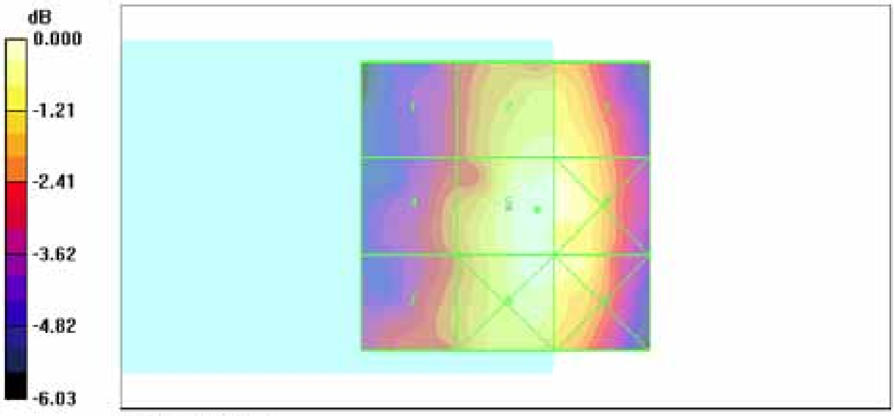
Communication System: CDMA ; Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Ambient Temperature : 20.8 ℃

DASY4 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 9/19/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch1013/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 72.5 V/m
Probe Modulation Factor = 0.99
Reference Value = 46.3 V/m; Power Drift = 0.023 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **52.7**	Grid 2 **67.9**	Grid 3 **67.7**
Grid 4 **58.3**	Grid 5 **72.5**	Grid 6 **71.4**
Grid 7 **58.5**	Grid 8 **72.0**	Grid 9 **69.6**



0 dB = 72.5V/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC-E_CDMA2000 Ch384_20070228_FCH-RC1

DUT: 741601

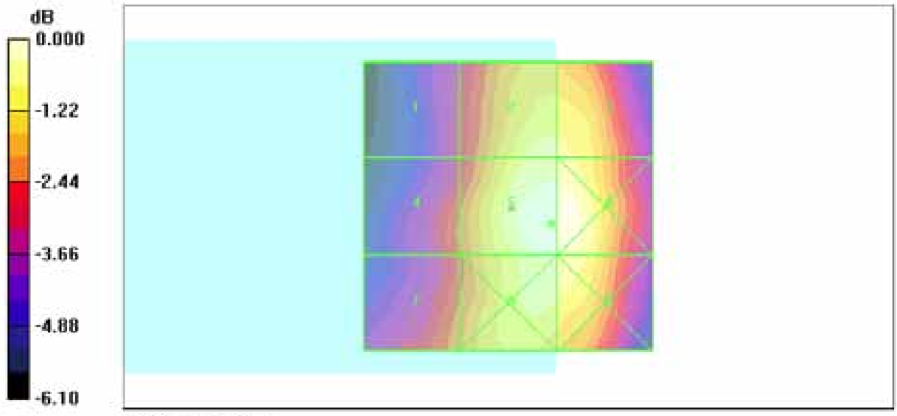
Communication System: CDMA ; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Ambient Temperature : 20.9 ℃

DASY4 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 9/19/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch384/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 87.1 V/m
Probe Modulation Factor = 0.99
Reference Value = 54.9 V/m; Power Drift = 0.137 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **60.9**	Grid 2 **81.5**	Grid 3 **81.0**
Grid 4 **66.4**	Grid 5 **87.1**	Grid 6 **86.9**
Grid 7 **68.1**	Grid 8 **83.9**	Grid 9 **83.7**



0 dB = 87.1V/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC-E_CDMA2000 Ch777_20070228_FCH-RC1

DUT: 741601

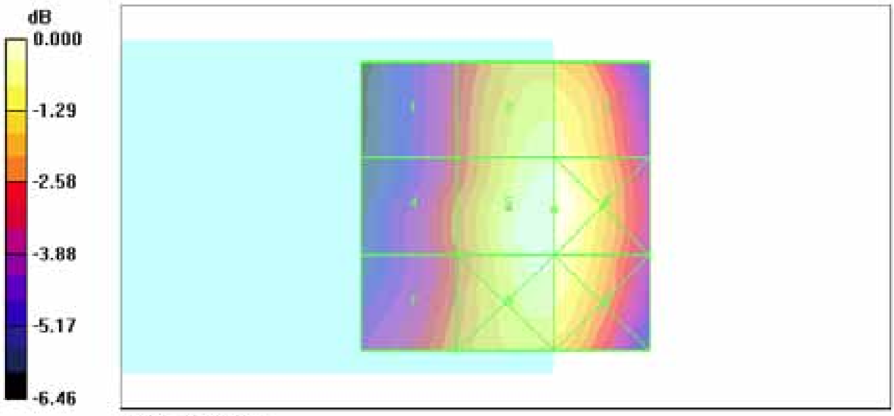
Communication System: CDMA ; Frequency: 848.31 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Ambient Temperature：20.8 ℃

DASY4 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 9/19/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch777/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 99.3 V/m
Probe Modulation Factor = 0.99
Reference Value = 63.6 V/m; Power Drift = -0.141 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **70.1**	Grid 2 **93.7**	Grid 3 **93.3**
Grid 4 **75.3**	Grid 5 **99.3**	Grid 6 **99.3**
Grid 7 **77.6**	Grid 8 **96.4**	Grid 9 **95.1**



0 dB = 99.3V/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC-E_CDMA2000 Ch25_20070228_FCH-RC1

DUT: 741601

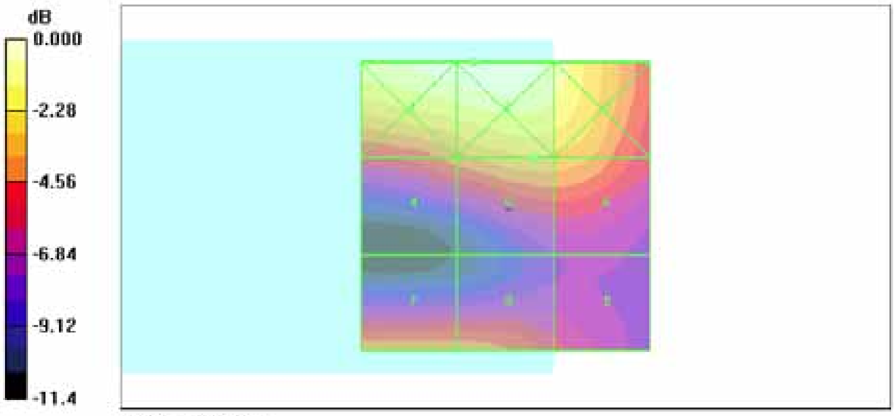
Communication System: CDMA ; Frequency: 1851.25 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Ambient Temperature : 20.8 ℃

DASY4 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 9/19/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch25/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 60.5 V/m
Probe Modulation Factor = 1.01
Reference Value = 52.9 V/m; Power Drift = -0.128 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **85.9**	Grid 2 **86.5**	Grid 3 **76.9**
Grid 4 **53.6**	Grid 5 **60.5**	Grid 6 **59.7**
Grid 7 **55.4**	Grid 8 **54.6**	Grid 9 **44.8**



0 dB = 86.5V/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC-E_CDMA2000 Ch600_20070228_FCH-RC1

DUT: 741601

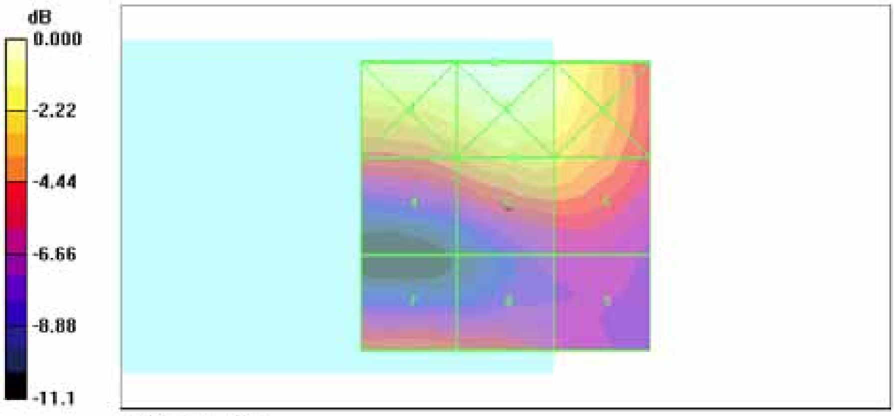
Communication System: CDMA ; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Ambient Temperature : 20.7 ℃

DASY4 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 9/19/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch600/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 52.4 V/m
Probe Modulation Factor = 1.01
Reference Value = 41.1 V/m; Power Drift = -0.091 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **70.8**	Grid 2 **71.2**	Grid 3 **62.8**
Grid 4 **46.4**	Grid 5 **52.4**	Grid 6 **52.0**
Grid 7 **42.7**	Grid 8 **41.3**	Grid 9 **34.2**



0 dB = 71.2V/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC-E_CDMA2000 Ch1175_20070228_FCH-RC1

DUT: 741601

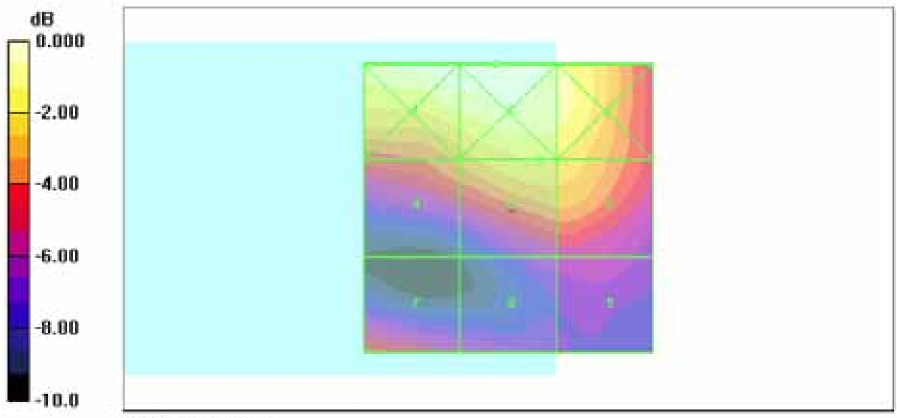
Communication System: CDMA ; Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Ambient Temperature : 20.7 ℃

DASY4 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 9/19/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch1175/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 51.3 V/m
Probe Modulation Factor = 1.01
Reference Value = 32.4 V/m; Power Drift = 0.183 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **63.5**	Grid 2 **64.0**	Grid 3 **57.5**
Grid 4 **44.5**	Grid 5 **51.3**	Grid 6 **50.8**
Grid 7 **38.8**	Grid 8 **33.5**	Grid 9 **32.5**



0 dB = 64.0V/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC-H_CDMA2000 Ch1013_20070228_FCH-RC1

DUT: 741601

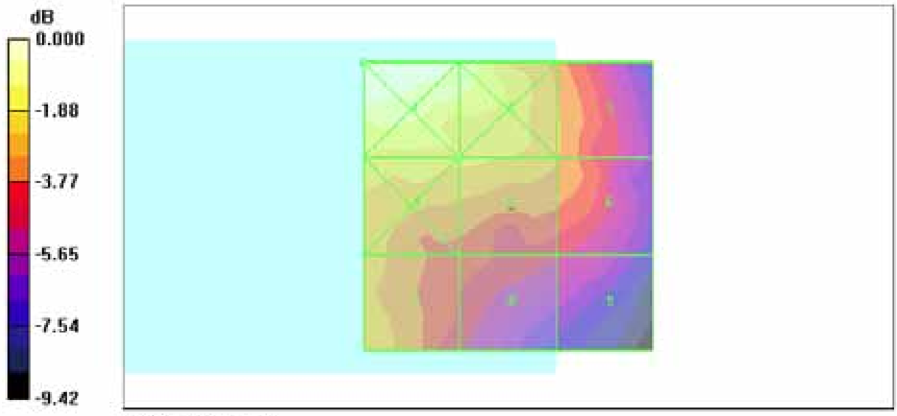
Communication System: CDMA ; Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Ambient Temperature : 20.6 ℃

DASY4 Configuration:
- Probe: H3DV6 - SN6184; ; Calibrated: 9/19/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch1013/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.156 A/m
Probe Modulation Factor = 0.97
Reference Value = 0.093 A/m; Power Drift = -0.086 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.201**	Grid 2 **0.183**	Grid 3 **0.142**
Grid 4 **0.162**	Grid 5 **0.156**	Grid 6 **0.141**
Grid 7 **0.150**	Grid 8 **0.126**	Grid 9 **0.114**



0 dB = 0.201A/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC-H_CDMA2000 Ch384_20070228_FCH-RC1

DUT: 741601

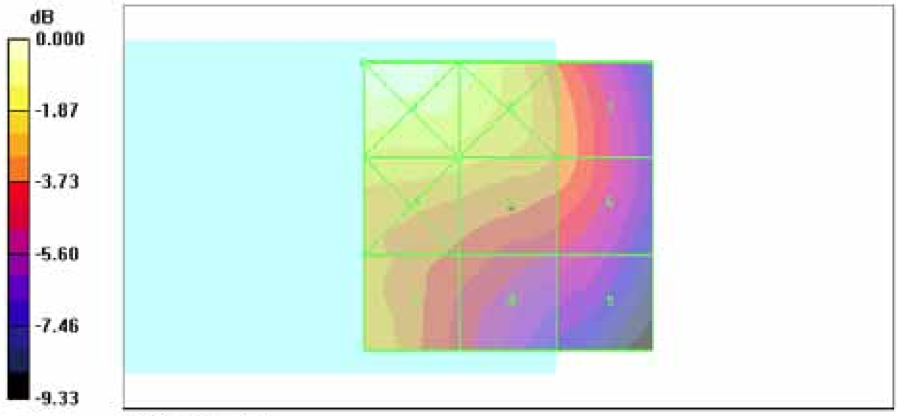
Communication System: CDMA ; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Ambient Temperature : 20.7 ℃

DASY4 Configuration:
- Probe: H3DV6 - SN6184; ; Calibrated: 9/19/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch384/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.199 A/m
Probe Modulation Factor = 0.97
Reference Value = 0.118 A/m; Power Drift = -0.057 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.256**	Grid 2 **0.230**	Grid 3 **0.179**
Grid 4 **0.206**	Grid 5 **0.199**	Grid 6 **0.177**
Grid 7 **0.191**	Grid 8 **0.164**	Grid 9 **0.143**



0 dB = 0.256A/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC-H_CDMA2000 Ch777_20070228_FCH-RC1

DUT: 741601

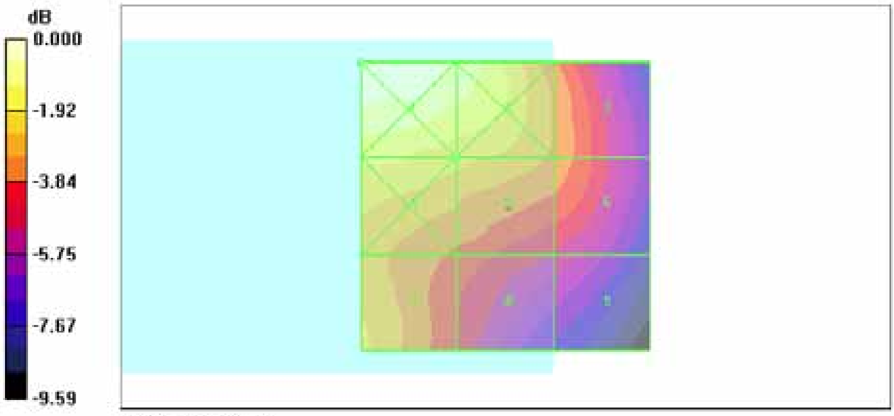
Communication System: CDMA ; Frequency: 848.31 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Ambient Temperature : 20.6 ℃

DASY4 Configuration:
- Probe: H3DV6 - SN6184; ; Calibrated: 9/19/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch777/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.222 A/m
Probe Modulation Factor = 0.97
Reference Value = 0.130 A/m; Power Drift = 0.153 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.288**	Grid 2 **0.260**	Grid 3 **0.198**
Grid 4 **0.235**	Grid 5 **0.222**	Grid 6 **0.196**
Grid 7 **0.220**	Grid 8 **0.183**	Grid 9 **0.159**



0 dB = 0.288A/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC-H_CDMA2000 Ch25_20070228_FCH-RC1

DUT: 741601

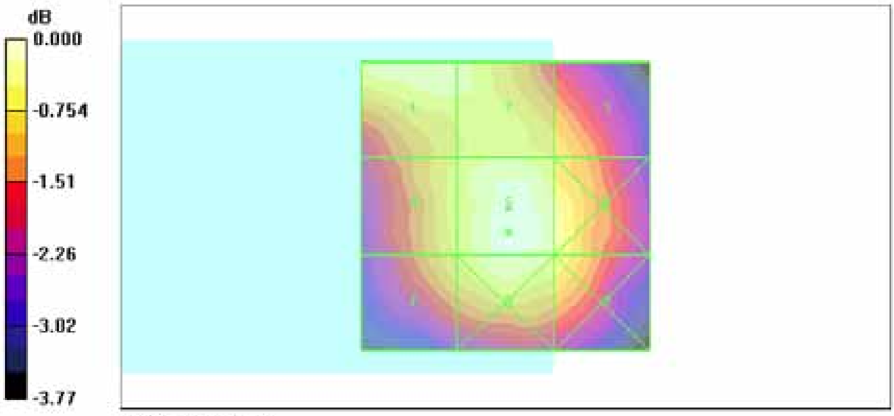
Communication System: CDMA ; Frequency: 1851.25 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Ambient Temperature : 20.6 ℃

DASY4 Configuration:
- Probe: H3DV6 - SN6184; ; Calibrated: 9/19/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch25/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.179 A/m
Probe Modulation Factor = 0.98
Reference Value = 0.093 A/m; Power Drift = 0.155 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.175**	Grid 2 **0.173**	Grid 3 **0.164**
Grid 4 **0.167**	Grid 5 **0.179**	Grid 6 **0.172**
Grid 7 **0.164**	Grid 8 **0.175**	Grid 9 **0.169**



0 dB = 0.179A/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC-H_CDMA2000 Ch600_20070228_FCH-RC1

DUT: 741601

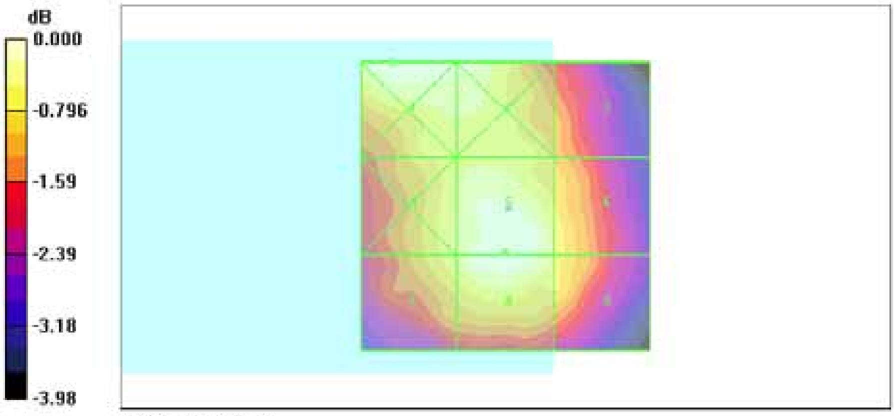
Communication System: CDMA ; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Ambient Temperature : 20.7 ℃

DASY4 Configuration:
- Probe: H3DV6 - SN6184; ; Calibrated: 9/19/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch600/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.139 A/m
Probe Modulation Factor = 0.98
Reference Value = 0.078 A/m; Power Drift = 0.016 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.140**	Grid 2 **0.139**	Grid 3 **0.123**
Grid 4 **0.132**	Grid 5 **0.139**	Grid 6 **0.131**
Grid 7 **0.132**	Grid 8 **0.139**	Grid 9 **0.131**



0 dB = 0.140A/m

Test Laboratory: Sporton International Inc. SAR Testing Lab

HAC-H_CDMA2000 Ch1175_20070228_FCH-RC1

DUT: 741601

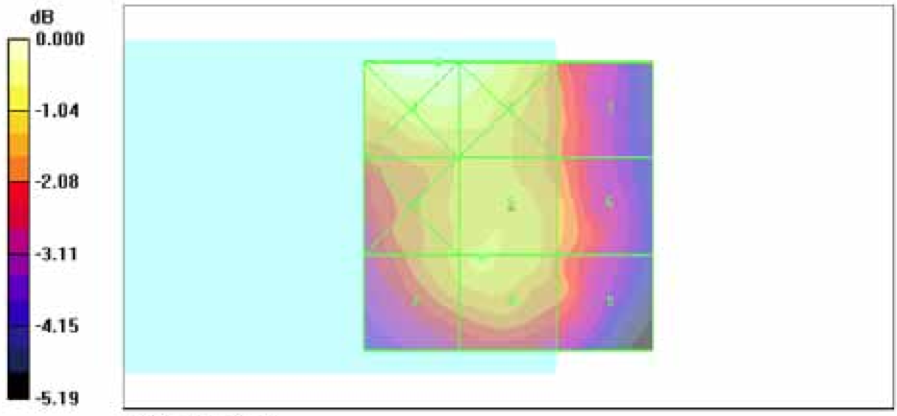
Communication System: CDMA ; Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Ambient Temperature : 20.8 ℃

DASY4 Configuration:
- Probe: H3DV6 - SN6184; ; Calibrated: 9/19/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 11/21/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch1175/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.124 A/m
Probe Modulation Factor = 0.98
Reference Value = 0.072 A/m; Power Drift = -0.084 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.138**	Grid 2 **0.136**	Grid 3 **0.111**
Grid 4 **0.120**	Grid 5 **0.124**	Grid 6 **0.115**
Grid 7 **0.120**	Grid 8 **0.124**	Grid 9 **0.112**



0 dB = 0.138A/m

Appendix C – Calibration Data

Calibration Laboratory of
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Sporton (Auden)**

Certificate No: **ER3-2358_Feb07**

CALIBRATION CERTIFICATE

Object	ER3DV6 - SN:2358
Calibration procedure(s)	QA CAL-02.v4 Calibration procedure for E-field probes optimized for close near field evaluations in air
Calibration date:	February 21, 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
Power meter E4419B	GB41293874	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41495277	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41498087	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-06 (METAS, No. 217-00592)	Aug-07
Reference 20 dB Attenuator	SN: S5086 (20b)	4-Apr-06 (METAS, No. 251-00558)	Apr-07
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-06 (METAS, No. 217-00593)	Aug-07
Reference Probe ER3DV6	SN: 2328	2-Oct-06 (SPEAG, No. ER3-2328_Oct06)	Oct-07
DAE4	SN: 654	21-Jun-06 (SPEAG, No. DAE4-654_Jun06)	Jun-07

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Fin Bomholt	R&D Director	

Issued: February 21, 2007

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Certificate No: ER3-2358_Feb07 Page 1 of 9

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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 1309-1996, " IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", 1996.

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).

Probe ER3DV6

SN:2358

Manufactured:	July 7, 2005
Last calibrated:	September 19, 2005
Recalibrated:	February 21, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ER3DV6 SN:2358 February 21, 2007

DASY - Parameters of Probe: ER3DV6 SN:2358

Sensitivity in Free Space [µV/(V/m)^2]		Diode Compression[A]	
NormX	1.69 ± 10.1 % (k=2)	DCP X	92 mV
NormY	1.54 ± 10.1 % (k=2)	DCP Y	92 mV
NormZ	1.61 ± 10.1 % (k=2)	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 -65 °

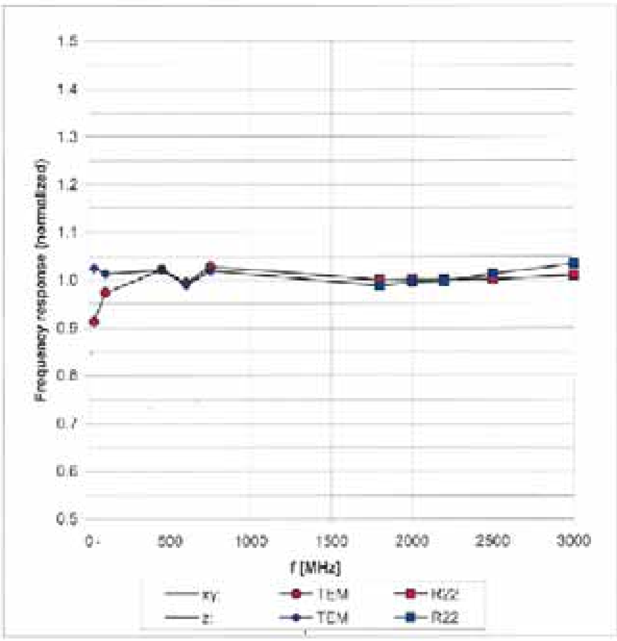
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] numerical linearization parameter: uncertainty not required

ER3DV6 SN:2358 February 21, 2007

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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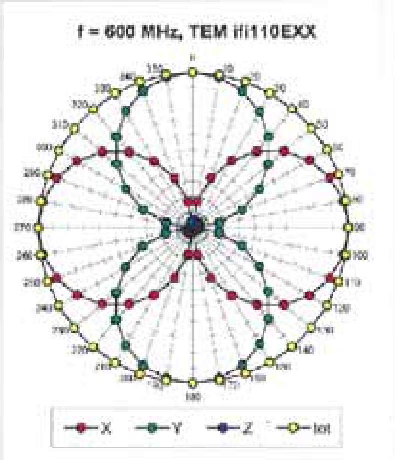
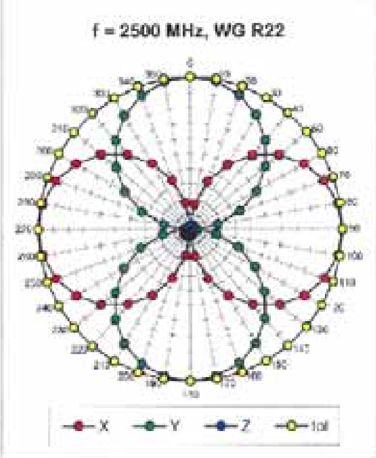
ER3DV6 SN:2358

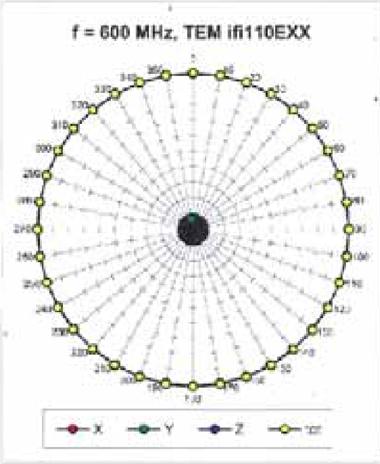
February 21, 2007

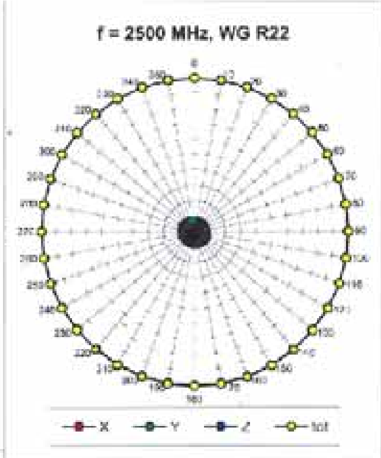
Receiving Pattern (ϕ), ϑ = 0°





Receiving Pattern (ϕ), ϑ = 90°





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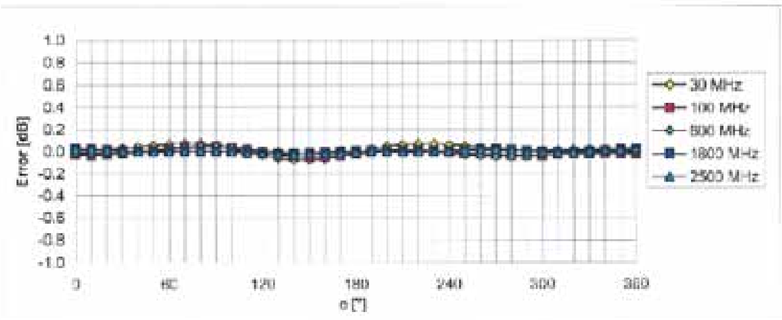
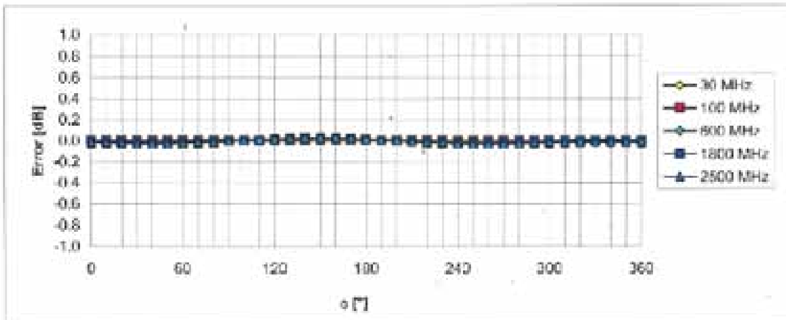
ER3DV6 SN:2358 February 21, 2007

Receiving Pattern (φ), ϑ = 0°



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

Receiving Pattern (φ), ϑ = 90°



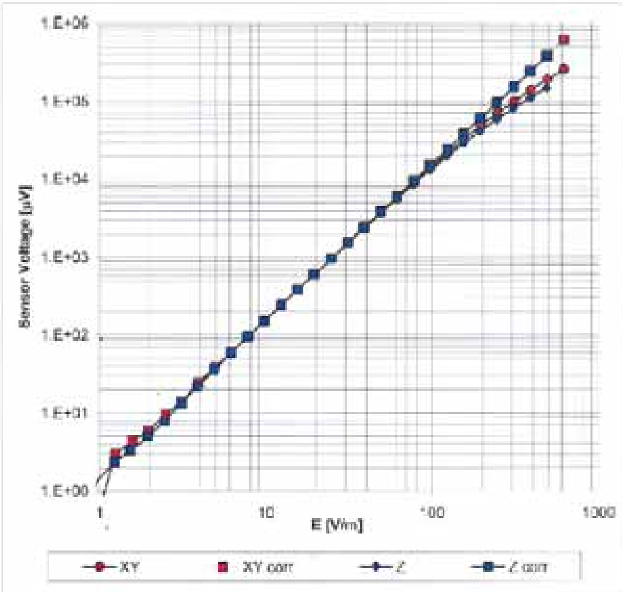
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

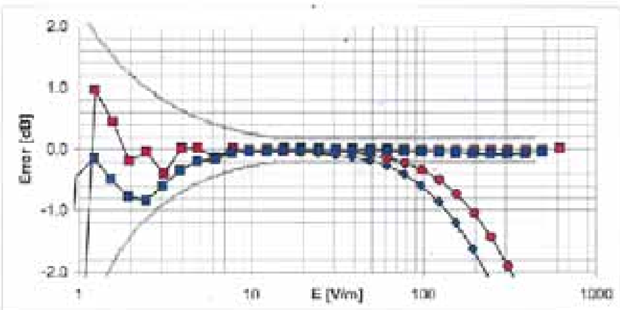
ER3DV6 SN:2358

February 21, 2007

Dynamic Range f(E-field)

(Waveguide R22, f = 1800 MHz)





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

Certificate No: ER3-2358_Feb07

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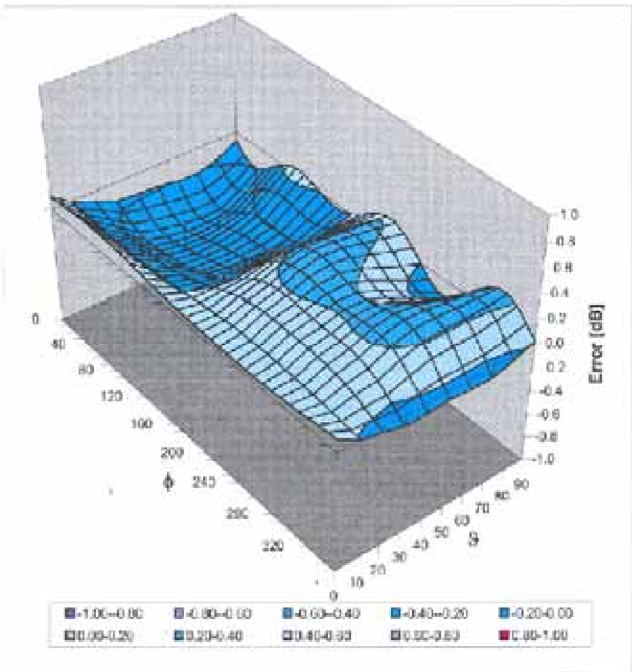
ER3DV6 SN:2358 February 21, 2007

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



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

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Accreditation No.: **SCS 108**

Client **Sporton (Auden)**

Certificate No: **H3-6184_Feb07**

CALIBRATION CERTIFICATE

Object	H3DV6 - SN:6184
Calibration procedure(s)	QA CAL-03.v4 Calibration procedure for H-field probes optimized for close near field evaluations in air
Calibration date:	February 21, 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
Power meter E4419B	GB41293874	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41495277	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41498087	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-06 (METAS, No. 217-00592)	Aug-07
Reference 20 dB Attenuator	SN: S5086 (20b)	4-Apr-06 (METAS, No. 251-00558)	Apr-07
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-06 (METAS, No. 217-00593)	Aug-07
Reference Probe H3DV6	SN: 6182	2-Oct-06 (SPEAG, No. H3-6182_Oct06)	Oct-07
DAE4	SN: 654	21-Jun-06 (SPEAG, No. DAE4-654_Jun06)	Jun-07

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct 07

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Fin Bomholt	R&D Director	

Issued: February 21, 2007

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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 1309-1996, " IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", 1996.

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).

H3DV6 SN:6184 February 21, 2007

Probe H3DV6

SN:6184

Manufactured: June 8, 2004
Last calibrated: September 19, 2005
Recalibrated: February 21, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

H3DV6 SN:6184 February 21, 2007

DASY - Parameters of Probe: H3DV6 SN:6184

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

	a0	a1	a2
X	2.461E-03	1.004E-5	1.195E-6 ± 5.1 % (k=2)
Y	2.498E-03	-3.536E-5	-1.454E-5 ± 5.1 % (k=2)
Z	2.915E-03	-2.323E-5	3.844E-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 -63 °

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%.

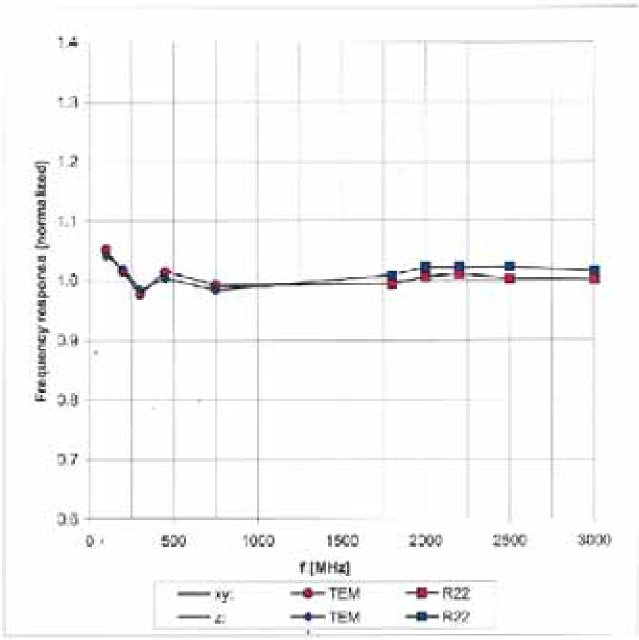
[1] numerical linearization parameter: uncertainty not required

Certificate No: H3-6184_Feb07 Page 4 of 6

H3DV6 SN:6184 February 21, 2007

Frequency Response of H-Field

(TEM-Cell:ifi110, Waveguide R22)

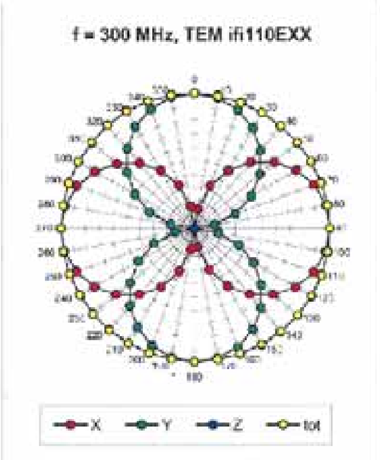


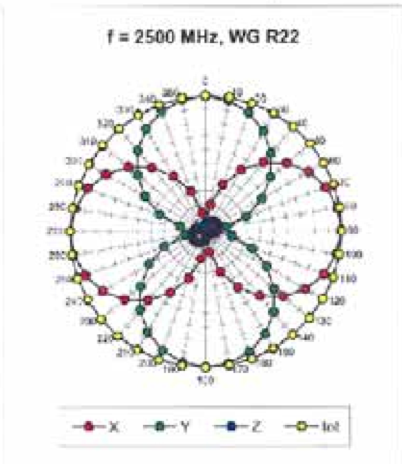
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Certificate No: H3-6184_Feb07 Page 5 of 8

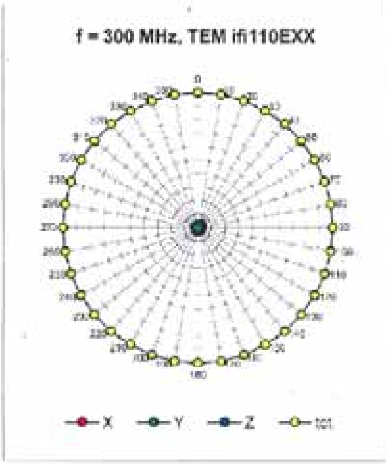
H3DV6 SN:6184 February 21, 2007

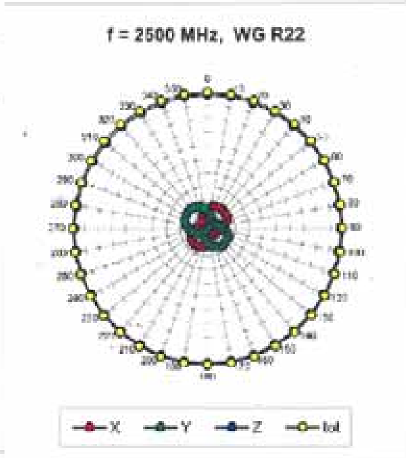
Receiving Pattern (ϕ), ϑ = 90°





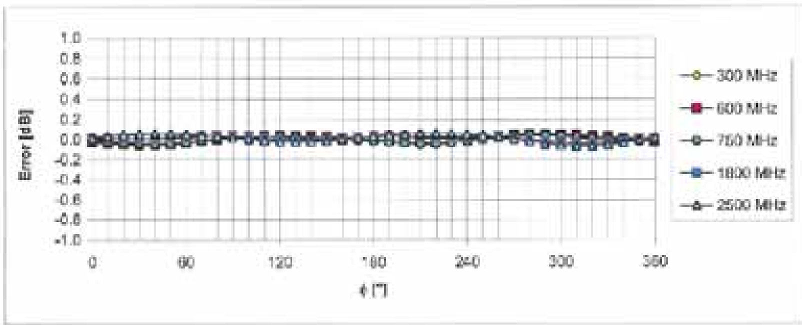
Receiving Pattern (ϕ), ϑ = 0°





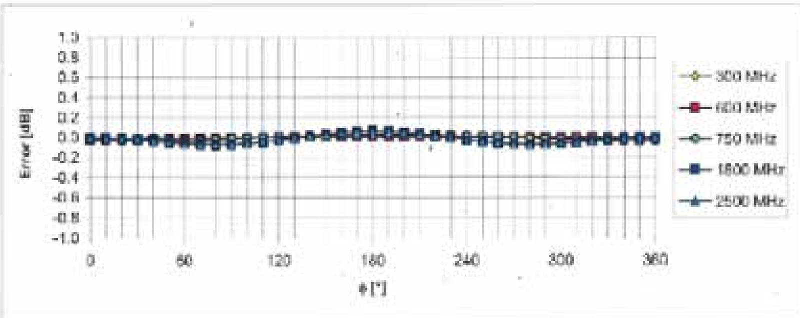
H3DV6 SN:6184 February 21, 2007

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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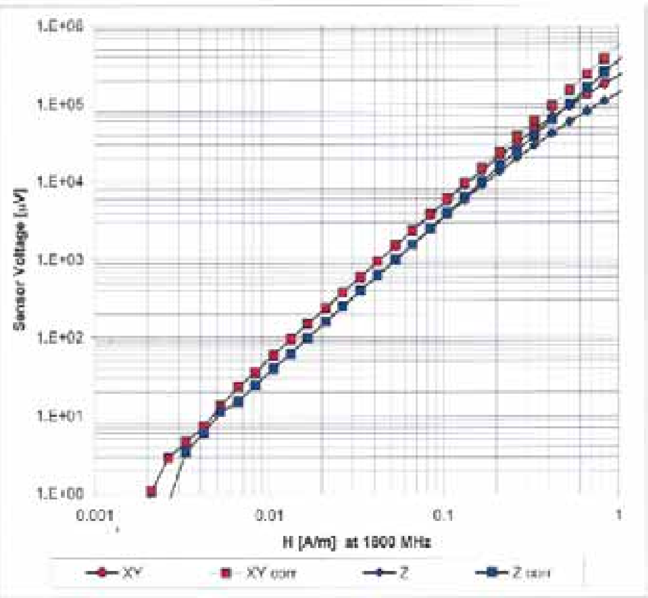
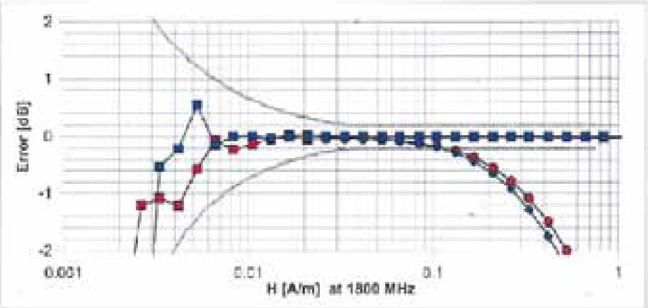
H3DV6 SN:6184 February 21, 2007

Dynamic Range f(H-field)

(Waveguide R22, f = 1800 MHz)





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

Certificate No: H3-6184_Feb07 Page 8 of 8

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

Client **Sporton (Auden)** Certificate No: **CD835V3-1045_Sep05**

CALIBRATION CERTIFICATE

Object	CD835V3 - SN: 1045
Calibration procedure(s)	QA CAL-20.v3 Calibration procedure for dipoles in air
Calibration date:	September 15, 2005
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 at an 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	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Power sensor HP 8481A	US37292783	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Reference 20 dB Attenuator	SN: 5086 (20g)	11-Aug-05 (METAS, No 251-00498)	Aug-06
Reference 10 dB Attenuator	SN: 5047.2 (10r)	11-Aug-05 (METAS, No 251-00498)	Aug-06
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Power meter EPM-4419B	GB43310788	10-Aug-03 (SPEAG, in house check Jan-04)	In house check: Oct-05
Power sensor HP 8481A	MY41092312	10-Aug-03 (SPEAG, in house check Jan-04)	In house check: Oct-05
Power sensor HP 8481A	MY41093315	10-Aug-03 (SPEAG, in house check Jan-04)	In house check: Oct-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov-05
RF generator R&S SMT06	1039.2000.06	26-Jul-04 (SPEAG, in house check Jul-04)	In house check: Jan-06
DAE4	SN: 660	16-Dec-04 (SPEAG, No. DAE4-901_Dec04)	Calibration, Dec-05
Probe ER3DV6	SN: 2336	20-Jan-05 (SPEAG, No. ER3-2336_Jan05)	Calibration, Jan-06
Probe H3DV6	SN: 6065	10-Dec-04 (SPEAG, No. H3-6065-Dec04)	Calibration, Dec-05

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

Issued: September 19, 2005

This calibration certificate is issued as an intermediate solution until the specific calibration procedure is accepted in the frame of the accreditation of the Calibration Laboratory of Schmid & Partner Engineering AG (based on ISO/IEC 17025 International Standard)

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

References

[1] ANSI-PC63.19-2001 (Draft 3.x, 2005)
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.

1 **Measurement Conditions**

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

DASY Version	DASY4	V4.6 B19
DASY PP Version	SEMCAD	V1.8 B159
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 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	164.1 V/m
Maximum measured above low end	100 mW forward power	161.5 V/m
Averaged maximum above arm	100 mW forward power	**162.8 V/m**

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

3 **Appendix**

3.1 **Antenna Parameters**

Frequency	**Return Loss**	**Impedance**
800 MHz	16.0 dB	(39.9 – j10.2) Ohm
835 MHz	**34.3 dB**	**(50.9 + j1.7) Ohm**
900 MHz	17.2 dB	(48.9 – j13.8) Ohm
950 MHz	18.1 dB	(51.2 + j12.7) Ohm
960 MHz	14.4 dB	(63.6 + j17.2) 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.

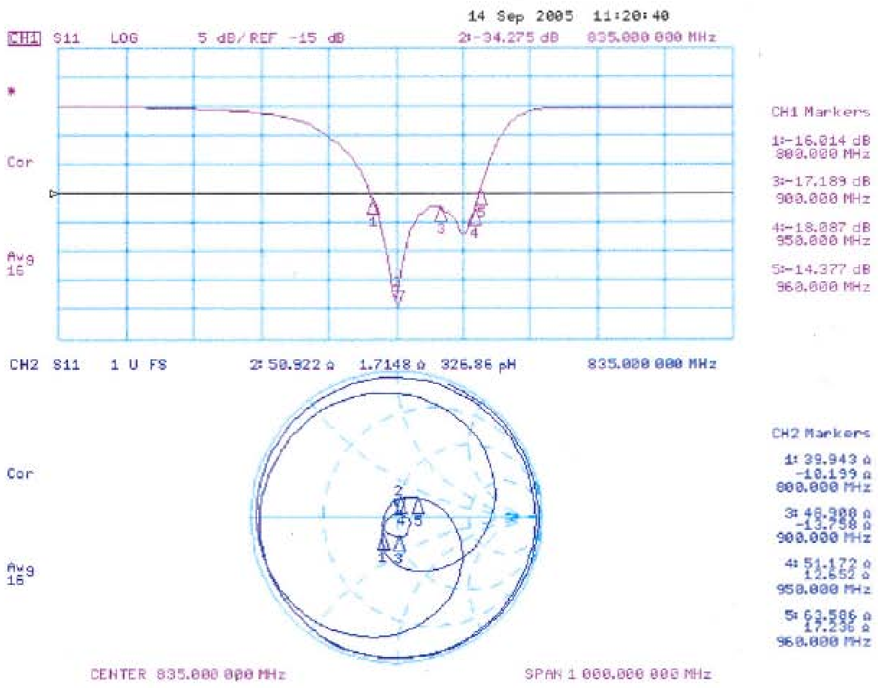
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

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.

3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



Certificate No: CD835V3-1045_Sep05 Page 4 of 6

3.3.2 DASY4 H-field result

Date/Time: 9/15/2005 4:24:45 PM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1045

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
Phantom section: H Dipole Section

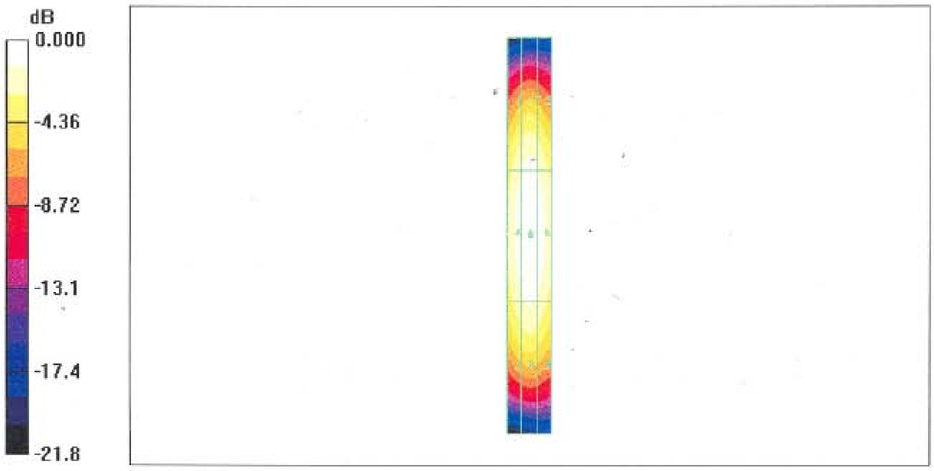
DASY4 Configuration:

- Probe: H3DV6 - SN6065; Calibrated: 12/10/2004
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 12/16/2004
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 159

H Scan 10mm above CD 835 MHz/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
Reference Value = 0.484 A/m; Power Drift = -0.025 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 0.382	Grid 2 0.408	Grid 3 0.388
Grid 4 0.425	Grid 5 0.453	Grid 6 0.434
Grid 7 0.369	Grid 8 0.393	Grid 9 0.376



0 dB = 0.453A/m

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3.3.3 DASY4 E-Field result

Date/Time: 9/15/2005 11:35:46 AM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1045

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
Phantom section: E Dipole Section

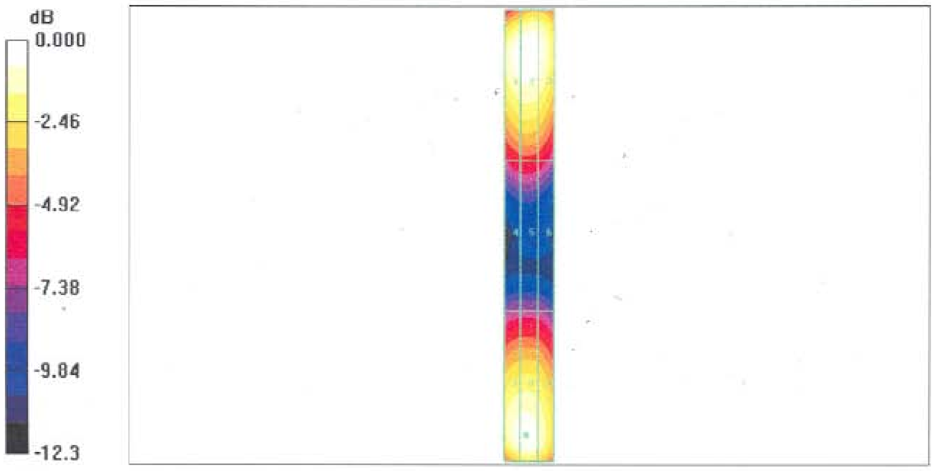
DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 1/20/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 12/16/2004
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 159

E Scan 10mm above CD 835 MHz/Hearing Aid Compatibility Test (41x361x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 164.1 V/m
Probe Modulation Factor = 1.00
Reference Value = 103.3 V/m; Power Drift = -0.011 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 161.3	Grid 2 164.1	Grid 3 158.0
Grid 4 88.2	Grid 5 89.6	Grid 6 85.9
Grid 7 158.6	Grid 8 161.5	Grid 9 153.1



0 dB = 164.1V/m

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

Client **Sporton (Auden)** Certificate No: **CD1880V3-1038_Sep05**

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1038
Calibration procedure(s)	QA CAL-20.v3 Calibration procedure for dipoles in air
Calibration date:	September 13, 2005
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 at an 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	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Power sensor HP 8481A	US37292783	12-Oct-04 (METAS, No. 251-00412)	Oct-05
20 dB Attenuator	SN: 5086 (20g)	11-Aug-05 (METAS, No 251-00498)	Aug-06
10 dB Attenuator	SN: 5047.2 (10r)	11-Aug-05 (METAS, No 251-00498)	Aug-06

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-4419B	GB43310788	10-Aug-03 (SPEAG, in house check Jan-04)	In house check: Oct-05
Power sensor HP 8481A	MY41092312	10-Aug-03 (SPEAG, in house check Jan-04)	In house check: Oct-05
Power sensor HP 8481A	MY41093315	10-Aug-03 (SPEAG, in house check Jan-04)	In house check: Oct-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov-05
RF generator R&S SMT06	1039.2000.06	26-Jul-04 (SPEAG, in house check Jul-04)	In house check: Jan-06
DAE4	SN: 660	16-Dec-04 (SPEAG, No. DAE4-660_Dec04)	Calibration, Dec-05
Probe ER3DV6	SN: 2336	20-Jan-05 (SPEAG, No. ER3-2336_Jan05)	Calibration, Jan-06
Probe H3DV6	SN: 6065	10-Dec-04 (SPEAG, No. H3-6065-Dec04)	Calibration, Dec-05

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

Issued: September 16, 2005

This calibration certificate is issued as an intermediate solution until the specific calibration procedure is submitted and accepted in the frame of the accreditation of the Calibration Laboratory of Schmid & Partner Engineering AG (based on ISO/IEC 17025 International Standard)

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

References

[1] ANSI-PC63.19-2001 (Draft 3.x, 2005)
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.

1 **Measurement Conditions**

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

DASY Version	DASY4	V4.6 B19
DASY PP Version	SEMCAD	V1.8 B159
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	**0.456 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	134.5 V/m
Maximum measured above low end	100 mW forward power	132.9 V/m
Averaged maximum above arm	100 mW forward power	**133.7 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	(57.2 + j9.4) Ohm
1880 MHz	**22.2 dB**	**(58.0 + j2.5) Ohm**
1900 MHz	22.6 dB	(58.0 – j0.5) Ohm
1950 MHz	26.6 dB	(49.9 – j4.7) Ohm
2000 MHz	19.7 dB	(42.7 + j6.3) Ohm

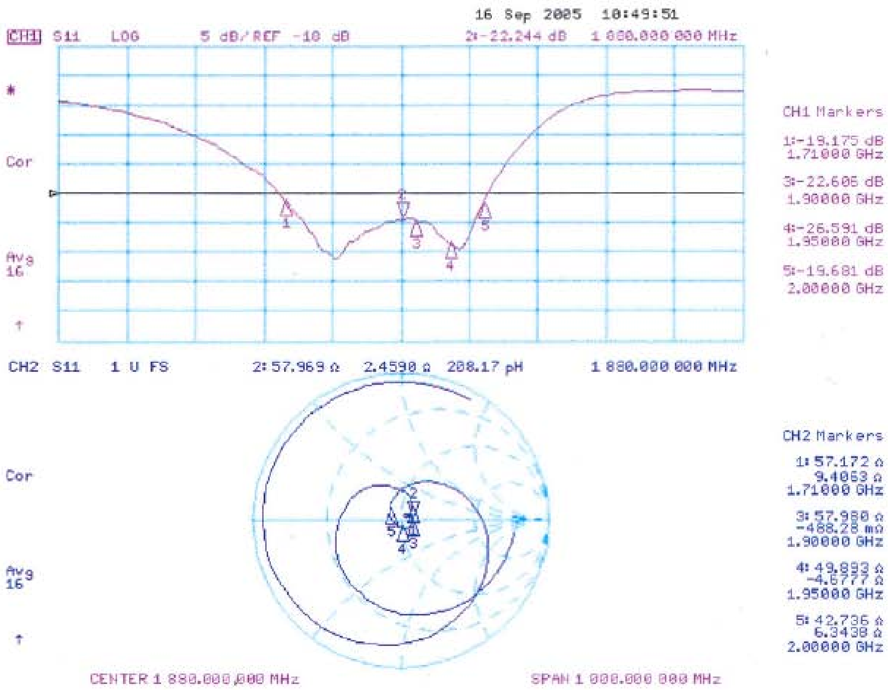
3.2 **Antenna Design and Handling**

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.

3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



Certificate No: CD1880V3-1038_Sep05 Page 4 of 6

3.3.2 DASY4 H-field result

Date/Time: 13.09.2005 11:47:45

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1038

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
Phantom section: H Dipole Section
Measurement Standard: DASY4 (High Precision Assessment)

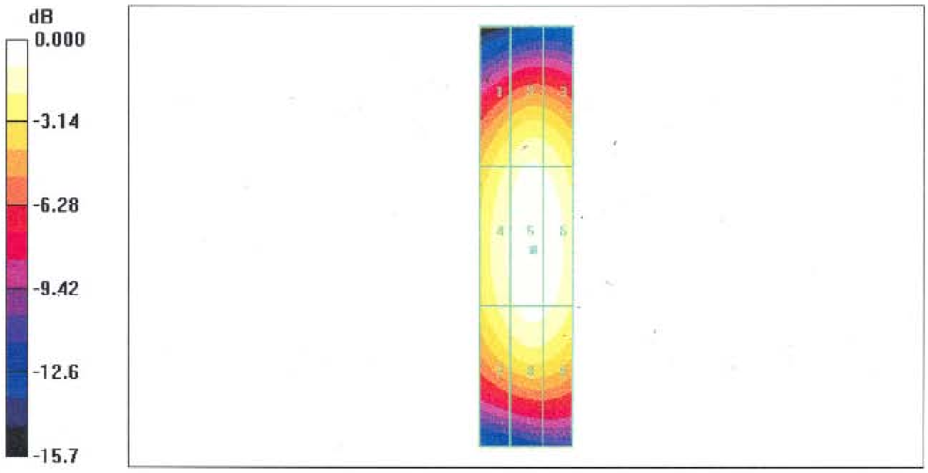
DASY4 Configuration:

- Probe: H3DV6 - SN6065; Calibrated: 10.12.2004
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 16.12.2004
- Phantom: HAC Test Arch; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 159

H Scan 10mm above CD1880V3/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.456 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.478 A/m; Power Drift = 0.005 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 0.370	Grid 2 0.411	Grid 3 0.405
Grid 4 0.416	Grid 5 0.456	Grid 6 0.449
Grid 7 0.388	Grid 8 0.426	Grid 9 0.419



0 dB = 0.456A/m

Certificate No: CD1880V3-1038_Sep05 Page 5 of 6

3.3.3 DASY4 E-Field result

Date/Time: 9/13/2005 3:47:19 PM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1038

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
Phantom section: E Dipole Section

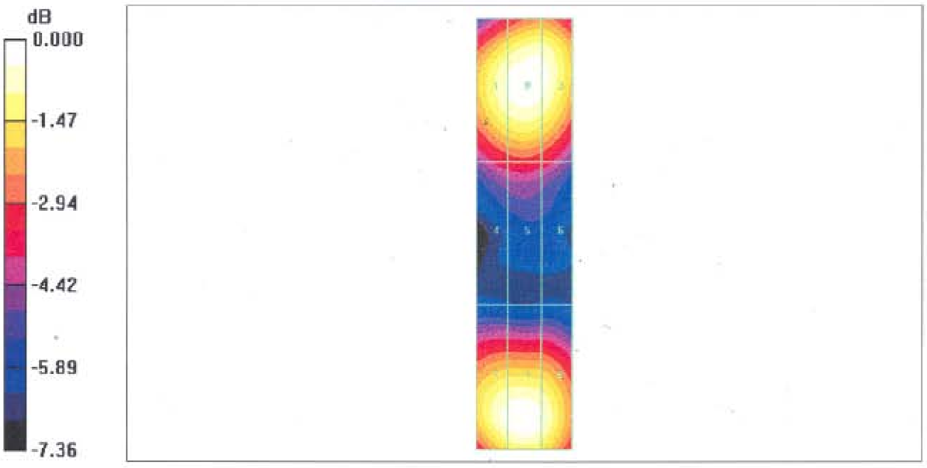
DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 1/20/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 12/16/2004
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.6 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 159

E Scan 10mm above CD1880V3/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 134.5 V/m
Probe Modulation Factor = 1.00
Reference Value = 152.7 V/m; Power Drift = -0.011 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **128.4**	Grid 2 **132.9**	Grid 3 **130.8**
Grid 4 **90.7**	Grid 5 **93.0**	Grid 6 **89.7**
Grid 7 **130.7**	Grid 8 **134.5**	Grid 9 **129.2**



0 dB = 134.5V/m

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

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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

Client **Sporton (Auden)** **Certificate No: DAE3-577_Nov06**

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 21, 2006
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	13-Oct-06 (Elcal AG, No: 5492)	Oct-07
Keithley Multimeter Type 2001	SN: 0810278	03-Oct-06 (Elcal AG, No: 5478)	Oct-07
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Calibrator Box V1.1	SE UMS 006 AB 1002	15-Jun-06 (SPEAG, in house check)	In house check Jun-07

	Name	Function	Signature
Calibrated by:	Eric Hainfeld	Technician	
Approved by:	Fin Bomholt	R&D Director	

Issued: November 21, 2006

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

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Calibration Laboratory of
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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 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.

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	404.355 ± 0.1% (k=2)	403.806 ± 0.1% (k=2)	404.276 ± 0.1% (k=2)
Low Range	3.92854 ± 0.7% (k=2)	3.93862 ± 0.7% (k=2)	3.93591 ± 0.7% (k=2)

Connector Angle

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

Appendix

1. DC Voltage Linearity

High Range		Input (µV)	Reading (µV)	Error (%)
Channel X	+ Input	200000	199999.5	0.00
Channel X	+ Input	20000	20005.87	0.03
Channel X	- Input	20000	-19998.71	-0.01
Channel Y	+ Input	200000	200000	0.00
Channel Y	+ Input	20000	20004.22	0.02
Channel Y	- Input	20000	-20003.23	0.02
Channel Z	+ Input	200000	200000.6	0.00
Channel Z	+ Input	20000	20005.24	0.03
Channel Z	- Input	20000	-20001.80	0.01

Low Range		Input (µV)	Reading (µV)	Error (%)
Channel X	+ Input	2000	1999.9	0.00
Channel X	+ Input	200	200.27	0.13
Channel X	- Input	200	-200.73	0.36
Channel Y	+ Input	2000	2000.1	0.00
Channel Y	+ Input	200	199.22	-0.39
Channel Y	- Input	200	-200.86	0.43
Channel Z	+ Input	2000	1999.9	0.00
Channel Z	+ Input	200	199.28	-0.36
Channel Z	- Input	200	-200.94	0.47

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	14.24	12.49
	- 200	-12.13	-12.92
Channel Y	200	-6.51	-7.06
	- 200	6.05	5.81
Channel Z	200	1.09	0.86
	- 200	-2.86	-2.63

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	-	2.51	0.09
Channel Y	200	0.43	-	3.37
Channel Z	200	-0.55	0.96	-

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	15970	16306
Channel Y	15851	16305
Channel Z	16208	17068

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	-0.51	-1.55	0.47	0.50
Channel Y	-2.06	-4.32	-0.65	0.60
Channel Z	-1.63	-2.56	-0.15	0.35

6. Input Offset Current

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

7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.2000	199.8
Channel Y	0.2000	200.7
Channel Z	0.2000	199.8

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