

Hearing Aid Compatibility (HAC) RF Emissions Test Report

APPLICANT : ZTE CORPORATION
EQUIPMENT : CDMA 1*RTT Digital Mobile Handset
BRAND NAME : ZTE
MODEL NAME : ZTE-C F350
FCC ID : Q78-ZTECF350
STANDARD : FCC 47 CFR §20.19
ANSI C63.19-2007
M CATEGORY : M4

The product was received on Jan. 14, 2010 and completely tested on Jan. 29, 2010. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by:



Roy Wu / Manager



SPORTON INTERNATIONAL INC.

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



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1. Statement of Compliance

The maximum results of RF Emission of Hearing Aid Compliance (HAC) were found during testing for the **ZTE CORPORATION CDMA 1*RTT Digital Mobile Handset ZTE ZTE-C F350**, which are as follows (with expanded uncertainty $\pm 30.4\%$ for E-field and $\pm 21.6\%$ for H-field):

Band	HAC RF Emission Test Result		M Rating
CDMA2000 BC0	E-Field (V/m)	82.0	M4
	H-Field (A/m)	0.133	M4
CDMA2000 BC1	E-Field (V/m)	48.0	M3
	H-Field (A/m)	0.114	M3

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

Results Summary : M Category = M4 (ANSI C63.19-2007)



2. Administration Data

2.1 Testing Laboratory

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No. 52, Hwa Ya 1 st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	Sporton Site No. : SAR01-HY

2.2 Applicant

Company Name	ZTE CORPORATION
Address	ZTE Plaza, Keji Road South, Hi-Tech Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P.R. China

2.3 Manufacturer

Company Name	ZTE CORPORATION
Address	ZTE Plaza, Keji Road South, Hi-Tech Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P.R. China

2.4 Application Details

Date of Receipt of Application	Jan. 14, 2010
Date of Start during the Test	Jan. 29, 2010
Date of End during the Test	Jan. 29, 2010



3. General Information

3.1 Description of Device Under Test (DUT)

Product Feature & Specification	
DUT Type	CDMA 1*RTT Digital Mobile Handset
Brand Name	ZTE
Model Name	ZTE-C F350
FCC ID	Q78-ZTECF350
Tx Frequency	CDMA2000 BC0 : 824 MHz ~ 849 MHz CDMA2000 BC1 : 1850 MHz ~ 1910 MHz
Rx Frequency	CDMA2000 BC0 : 869 MHz ~ 894 MHz CDMA2000 BC1 : 1930 MHz ~ 1990 MHz
Maximum Output Power to Antenna	CDMA2000 BC0 : 23.72 dBm CDMA2000 BC1 : 23.96 dBm
Antenna Type	Fixed Internal Antenna
HW Version	1.2
SW Version	ZTEF350V1.0.0B07
Type of Modulation	QPSK
DUT Stage	Identical Prototype

List of Accessory:

Specification of Accessory		
Battery	Brand Name	ZTE
	Model Name	Li3709T42P3h453756
	Power Rating	3.7V, 900mAh
	Type	Li-ion

Remark: The above DUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

3.2 Product Photos

Refer to Appendix D.



3.3 Applied Standards

The ANSI Standard ANSI C63.19-2007 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



3.4 Test Conditions

3.4.1 Ambient Condition

Ambient Temperature	20 to 24 °C
Humidity	< 60 %

3.4.2 Test Configuration

The device was controlled by using a base station emulator Agilent 8960. Communication between the device and the emulator was established by air link. The power control bits was set to "Always Up" from the emulator to radiate maximum output power during all testing.

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



4. Hearing Aid Compliance (HAC)

4.1 Introduction

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

5. HAC RF Emission Measurement Setup

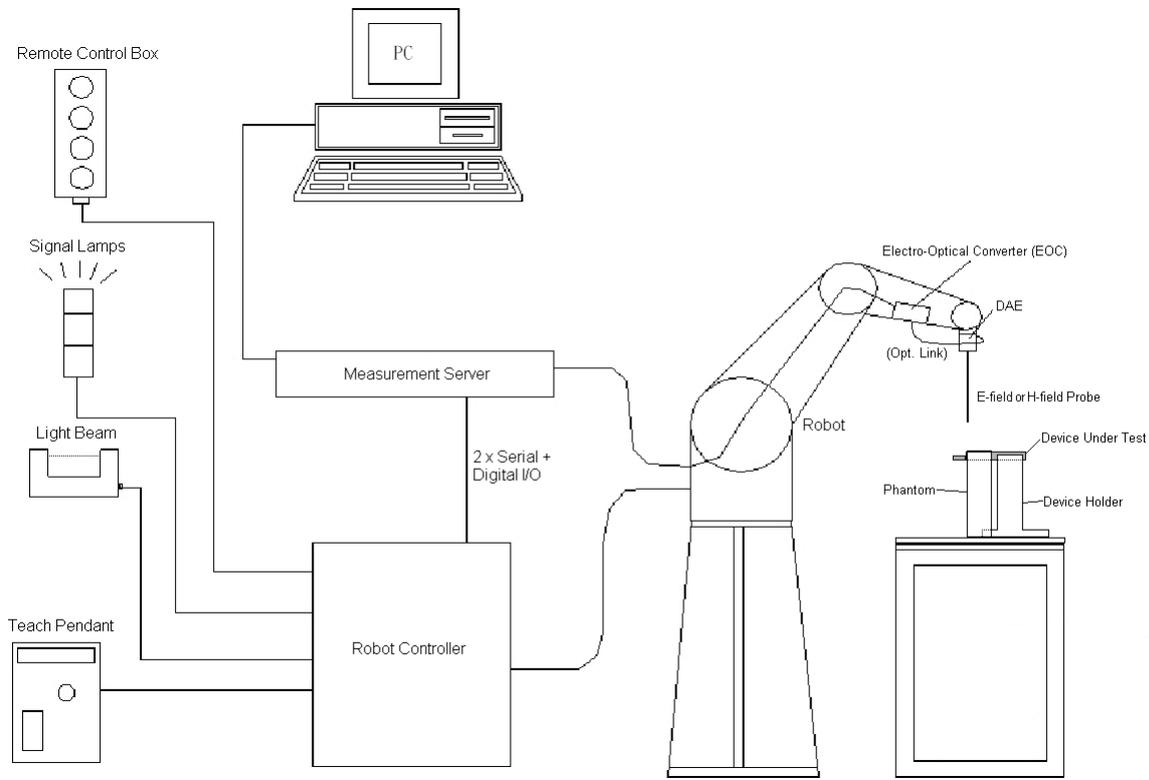


Fig 5.1 SPEAG DASY4 or DASY5 System Configurations

The DASY4 or DASY5 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 (ECO) 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 or DASY5 software
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom
- A device holder
- Tissue simulating liquid
- Dipole for evaluating the proper functioning of the system

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

5.1 E-Field and H-Field Probe System

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

5.1.1 E-Field Probe Specification

<ER3DV6>

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 $\pm 6.0\%$, $k=2$)
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 Photo of E-field Probe

5.1.2 H-Field Probe Description

<H3DV6>

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 $\pm 6.0\%$, $k=2$); 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 Photo of H-field Probe

5.1.3 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:

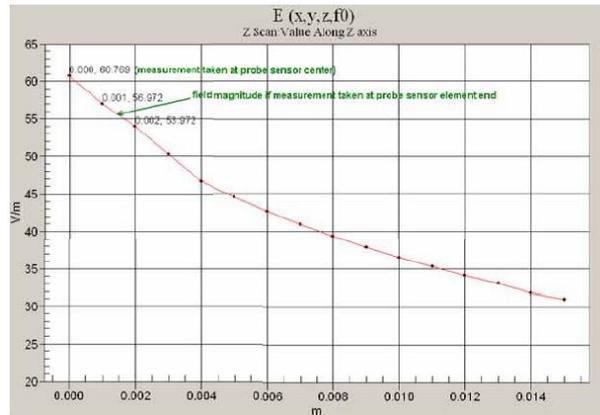


Fig 5.4 Z-Axis Scan at maximum point above a typical wireless device for E-field

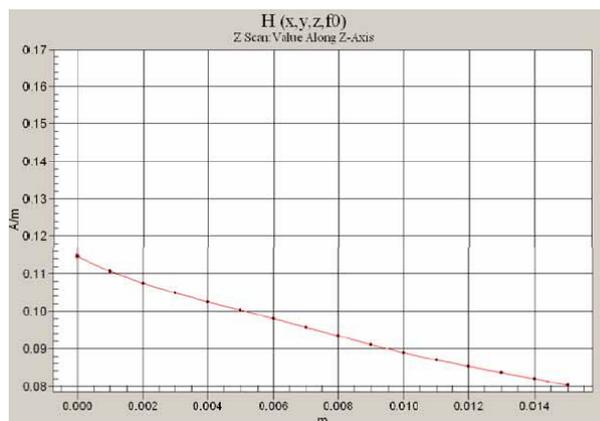


Fig 5.5 Z-Axis Scan at maximum point above a typical wireless device for H-field

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.

5.2 DATA Acquisition Electronics (DAE)

The data acquisition electronics (DAE) 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 input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.



Fig 5.6 Photo of DAE

5.3 Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90BL; DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB; DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ± 0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller



Fig 5.7 Photo of DASY4



Fig 5.8 Photo of DASY5

5.4 Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chipdisk (DASY4: 32 MB; DASY5: 128 MB), RAM (DASY4: 64 MB, DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

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



Fig 5.9 Photo of Server for DASY4



Fig 5.10 Photo of Server for DASY5

5.5 Phone Positioner

The phone positioner shown in Fig. 5.11 is used to adjust DUT to the suitable position.



Fig 5.11 Phone Positioner

5.6 Test Arch Phantom

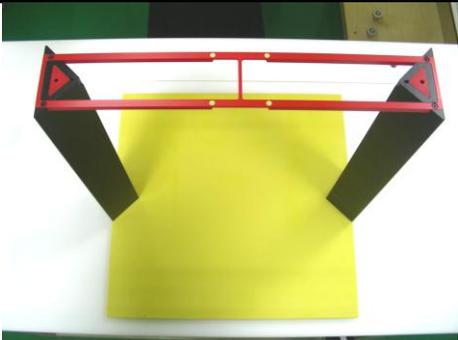
<p>Construction :</p>	<p>Enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot.</p>	
<p>Dimensions :</p>	<p>370 x 370 x 370 mm</p>	

Fig 5.12 Photo of Arch Phantom



5.7 Data Storage and Evaluation

5.7.1 Data Storage

The DASY 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. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings.

5.7.2 Data Evaluation

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

Probe parameters :	- Sensitivity	Norm _i , a _{i0} , a _{i1} , a _{i2}
	- Conversion factor	ConvF _i
	- Diode compression point	dcp _i
Device parameters :	- Frequency	f
	- Crest factor	cf
Media parameters :	- Conductivity	σ
	- Density	ρ

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

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

V_i = U_i + U_i^2 * (cf / dcp_i)

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

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

$$\text{E-field Probes : } \mathbf{E}_i = \sqrt{\frac{V_i}{\text{Norm}_i \cdot \text{ConvF}}}$$

$$\text{H-field Probes : } \mathbf{H}_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

- with V_i = compensated signal of channel i , ($i = x, y, z$)
- Norm_i = sensor sensitivity of channel i , ($i = x, y, z$), $\mu\text{V}/(\text{V}/\text{m})^2$ 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) :

$$\mathbf{E}_{\text{tot}} = \sqrt{\mathbf{E}_x^2 + \mathbf{E}_y^2 + \mathbf{E}_z^2}$$

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

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, DASYS 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

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Isotropic E-Field Probe	ER3DV6	2302	Jun. 23, 2009	Jun. 22, 2010
SPEAG	Isotropic H-Field Probe	H3DV6	6187	Jun. 24, 2009	Jun. 23, 2010
SPEAG	Audio Magnetic 1D Field Probe	AM1DV2	3067	Jan. 04, 2010	Jan. 03, 2011
SPEAG	Audio Magnetic Calibration Coil	AMCC	1049	NCR	NCR
SPEAG	Audio Measuring Instrument	AMMI	1041	NCR	NCR
SPEAG	835MHz Calibration Dipole	CD835V3	1045	Sep. 17, 2009	Sep. 16, 2011
SPEAG	1880MHz Calibration Dipole	CD1880V3	1038	Sep. 17, 2009	Sep. 16, 2011
SPEAG	2450MHz Calibration Dipole	CD2450V3	1039	Sep. 17, 2009	Sep. 16, 2011
SPEAG	Data Acquisition Electronics	DAE3	577	Aug. 24, 2009	Aug. 23, 2010
SPEAG	Data Acquisition Electronics	DAE4	778	Sep. 18, 2009	Sep. 17, 2010
SPEAG	Test Arch Phantom	N/A	N/A	NCR	NCR
SPEAG	Phone Positoiner	N/A	N/A	NCR	NCR
Agilent	Wireless Communication Test Set	E5515C	MY48360820	Dec. 15, 2008	Dec. 14, 2010
Agilent	Wireless Communication Test Set	E5515C	GB46311322	Feb. 16, 2009	Feb. 15, 2011
R&S	Universal Radio Communication Tester	CMU200	105934	Nov. 11, 2008	Nov. 10, 2009
Agilent	Dual Directional Coupler	778D	50422	NCR	NCR
AR	Power Amplifier	5S1G4M2	0328767	NCR	NCR
R&S	Spectrum Analyzer	FSP7	101131	Mar. 17, 2009	Mar. 16, 2010

Table 5.1 Test Equipment List

6. Uncertainty Assessment

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty 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 6.1.

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor ^(a)	1/k ^(b)	1/√3	1/√6	1/√2

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

(b) κ is the coverage factor

Table 6.1 Multiplying Factors for Various Distributions

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

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



Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (E)	Ci (H)	Standard Uncertainty (E)	Standard Uncertainty (H)
Measurement System							
Probe Calibration	5.1	Normal	1	1	1	± 5.1 %	± 5.1 %
Axial Isotropy	4.7	Rectangular	√3	1	1	± 2.7 %	± 2.7 %
Sensor Displacement	16.5	Rectangular	√3	1	0.145	± 9.5 %	± 1.4 %
Test Arch	7.2	Rectangular	√3	1	0	± 4.1 %	± 0.0 %
Linearity	4.7	Rectangular	√3	1	1	± 2.7 %	± 2.7 %
Scaling to Peak Envelope Power	0.0	Rectangular	√3	1	1	± 0.0 %	± 0.0 %
System Detection 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						± 15.2 %	± 10.8 %
Coverage Factor for 95 %						K = 2	
Expanded Uncertainty						± 30.4 %	± 21.6 %

Table 6.2 Uncertainty Budget of DASYS

7. HAC RF Emission 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. The calibrated dipole must be placed beneath the arch phantom. The equipment setup is shown below:

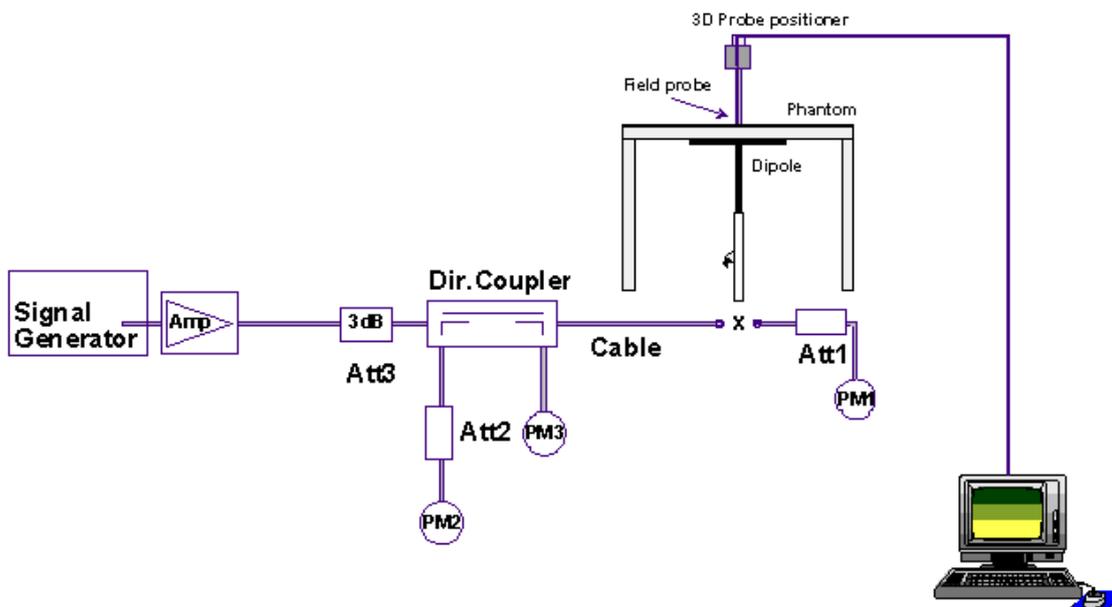


Fig. 7.1 System Setup of System Evaluation

1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. Calibrated Dipole

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



Fig 7.2 Dipole Setup

7.3 Validation Results

Comparing to the original E-field or H-field value provided by SPEAG, the validation data should be within its specification of 25 %. Table 7.1 shows the target value and measured value. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Frequency (MHz)	Input Power (dBm)	Target Value (V/m)	E-Field 1 (V/m)	E-Field 2 (V/m)	Average Value (V/m)	Deviation (%)	Date
835	20	170.2	187.4	177.6	182.5	7.23	Jan. 29, 2010
1880	20	136.8	156.1	156.2	156.15	14.14	Jan. 29, 2010
Frequency (MHz)	Input Power (dBm)	Target Value (A/m)	H-Field (A/m)		Deviation (%)	Date	
835	20	0.457	0.403		-11.82	Jan. 29, 2010	
1880	20	0.466	0.529		13.52	Jan. 29, 2010	

Table 7.1 Test Results of System Validation

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

8. RF Field Probe Modulation Factor

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

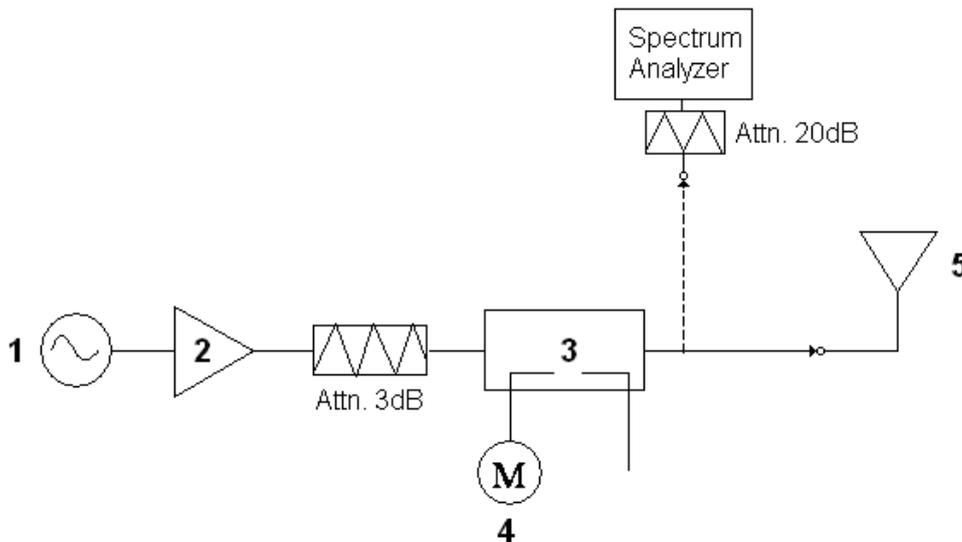


Fig. 8.1 System Calibration

This was done using the following procedure:

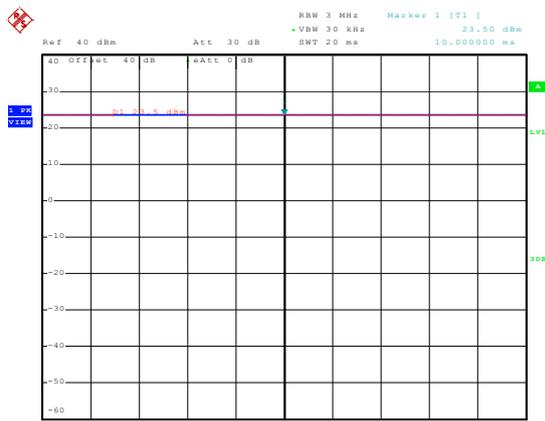
1. Fixing the probe in a set location relative to a field generating device.
2. Illuminate the probe with a CW signal at the intended measurement frequency.
3. Record the reading of the probe measurement system of the CW signal.
4. Determine the level of the CW signal being used to drive the field generating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



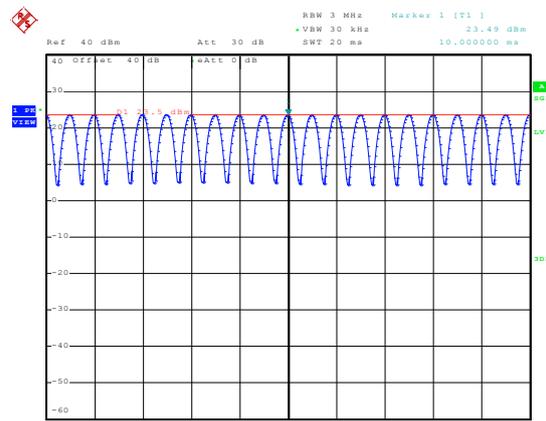
PMF Measurement Summary:

Frequency	Functions	E-field	H-field	PMF	
		V/m	A/m	E-field	H-field
835MHz	CW	248.0	0.705	-	-
835MHz	AM	153.6	0.462	1.615	1.526
835MHz	CDMA	255.8	0.757	0.97	0.931
835MHz	CMDA 1/8	85.7	0.261	2.89	2.70
1880MHz	CW	285.4	0.945	-	-
1880MHz	AM	173.5	0.697	1.645	1.356
1880MHz	CDMA	291.1	1.151	0.98	0.821
1880MHz	CMDA 1/8	92.6	0.350	3.08	2.70

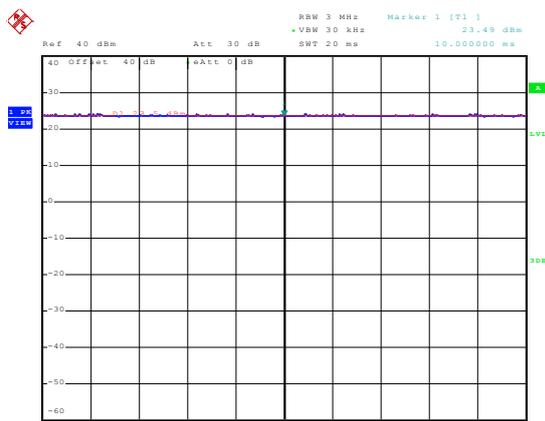
Zero span Spectrum Plots for RF Field Probe Modulation Factor



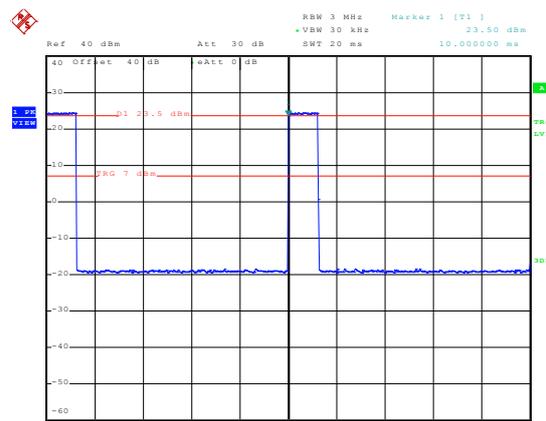
835MHz - CW



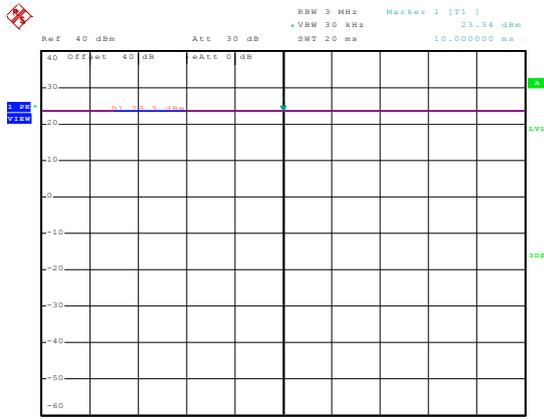
835MHz - 80% AM



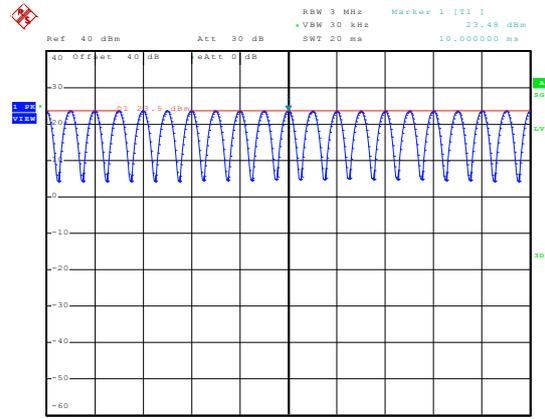
835MHz - CDMA (Full Rate)



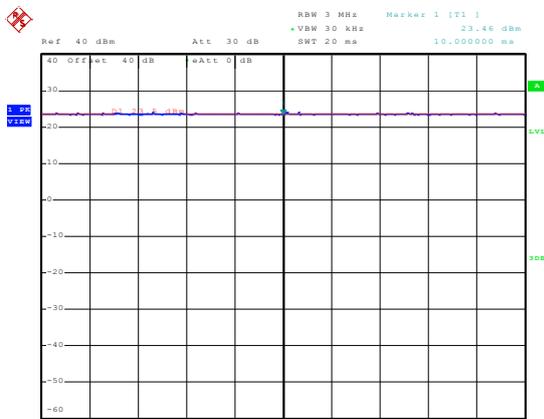
835MHz - CDMA (1/8 Rate)



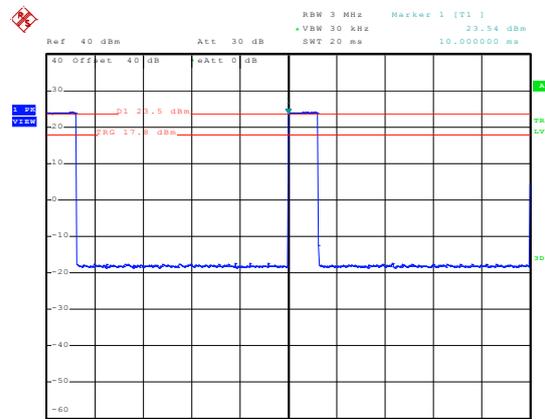
1900MHz - CW



1900MHz - 80% AM



1900MHz - CDMA (Full Rate)



1900MHz - CDMA (1/8 Rate)

9. Description for DUT Testing Position

The DUT was put on device holder and adjusted to the accurate and reliable position. Please refer to Appendix E for the Setup photographs.

Fig. 9.1 illustrate the references and reference plane that shall be used in a typical DUT emissions measurement. The principle of this section is applied to DUT with similar geometry.

- The grid is 5 cm by 5 cm area that is divided into 9 evenly sized blocks or sub-grids.
- The grid is centered on the audio frequency output transducer of the DUT.
- The grid is in a reference plane, which is defined as the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It is parallel to the centerline of the receiver area of the phone and is defined by the points of the receiver-end of the DUT handset, which, in normal handset use, rest against the ear.
- The measurement plane is parallel to, and 15 mm in front of, the reference plane.



Fig 9.1 A typical DUT reference and plane for HAC measurements

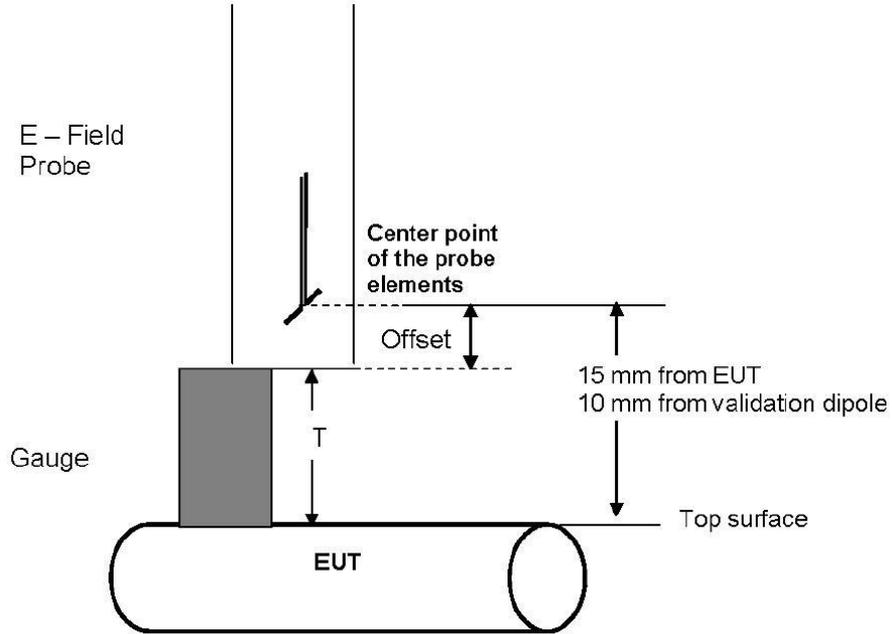


Fig. 9.2 Gauge block with E-field probe

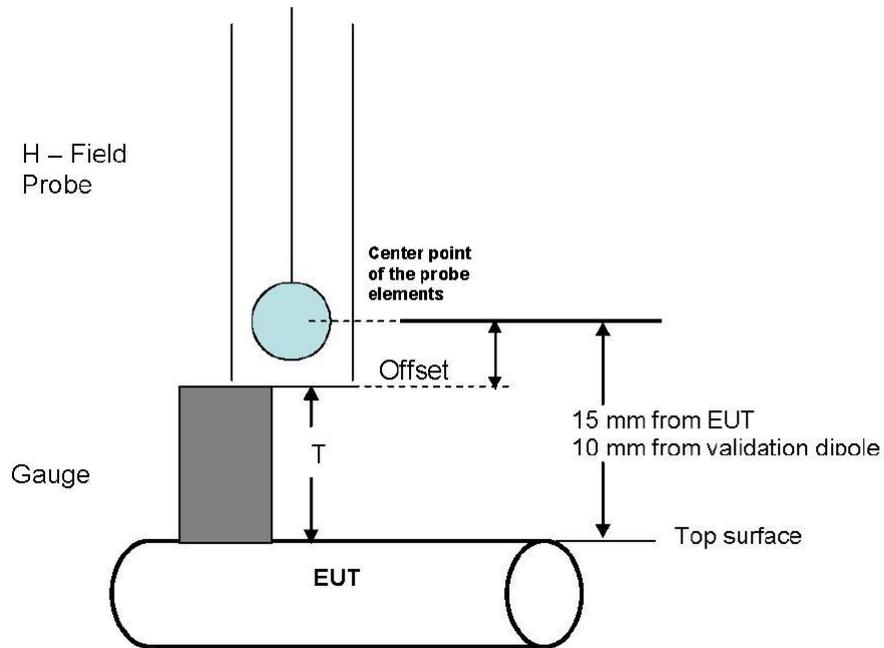


Fig. 9.3 Gauge block with H-field probe



10. RF Emissions Test Procedure

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

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



11. HAC RF Emission Test Results

11.1 Conducted Power (Unit: dBm)

Band	CDMA2000 BC0			CDMA2000 BC1		
Channel	1013	384	777	25	600	1175
Frequency	824.7	836.52	848.31	1851.25	1880	1908.75
RC1+SO3	23.62	23.58	23.62	23.52	23.64	23.75

11.2 E-Field Emission

Plot No.	Band	Mode	Channel	DUT Status	PMF	Peak E-Field (V/m)	M-Rating
#01	CDMA2000 BC0	RC1+SO3	384	Slide Off	2.89	64.8	M4
#02	CDMA2000 BC0	RC1+SO3	384	Slide Up	2.89	82.0	M4
#03	CDMA2000 BC0	RC1+SO3	1013	Slide Up	2.89	69.4	M4
#04	CDMA2000 BC0	RC1+SO3	777	Slide Up	2.89	78.9	M4
#09	CDMA2000 BC1	RC1+SO3	600	Slide Off	3.08	37.3	M4
#10	CDMA2000 BC1	RC1+SO3	600	Slide Up	3.08	33.5	M4
#11	CDMA2000 BC1	RC1+SO3	25	Slide Off	3.08	48.0	M4
#12	CDMA2000 BC1	RC1+SO3	1175	Slide Off	3.08	44.2	M4

11.3 H-Field Emission

Plot No.	Band	Mode	Channel	DUT Status	PMF	Peak H-Field (A/m)	M-Rating
#17	CDMA2000 BC0	RC1+SO3	384	Slide Off	2.70	0.103	M4
#18	CDMA2000 BC0	RC1+SO3	384	Slide Up	2.70	0.133	M4
#19	CDMA2000 BC0	RC1+SO3	1013	Slide Up	2.70	0.108	M4
#20	CDMA2000 BC0	RC1+SO3	777	Slide Up	2.70	0.129	M4
#25	CDMA2000 BC1	RC1+SO3	600	Slide Off	2.70	0.096	M4
#26	CDMA2000 BC1	RC1+SO3	600	Slide Up	2.70	0.064	M4
#27	CDMA2000 BC1	RC1+SO3	25	Slide Off	2.70	0.114	M4
#28	CDMA2000 BC1	RC1+SO3	1175	Slide Off	2.70	0.103	M4

Remark:

1. The CDMA2000 test mode was chosen from the maximum peak field shown as appendix F.
2. The volume was adjusted to maximum level and the backlight turned off during RF Emission testing.
3. The HAC mode software on this DUT was tuned on during HAC testing.
4. Test Engineer : Gordon Lin and Eric Huang



12. References

- [1] ANSI C63.19-2007, "American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids", 8 June 2007
- [2] SPEAG DASY System Handbook



Appendix A. Plots of System Performance Check

The plots are shown as follows.

HAC_E_Dipole_835_100129

DUT: HAC-Dipole 835 MHz

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.6 °C

DASY4 Configuration:

- Probe: ER3DV6 - SN2302; ConvF(1, 1, 1); Calibrated: 2009/6/23
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

E Scan - ER probe center 10mm above CD835 Dipole/Hearing Aid Compatibility

Test (41x361x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 187.4 V/m

Probe Modulation Factor = 1.00

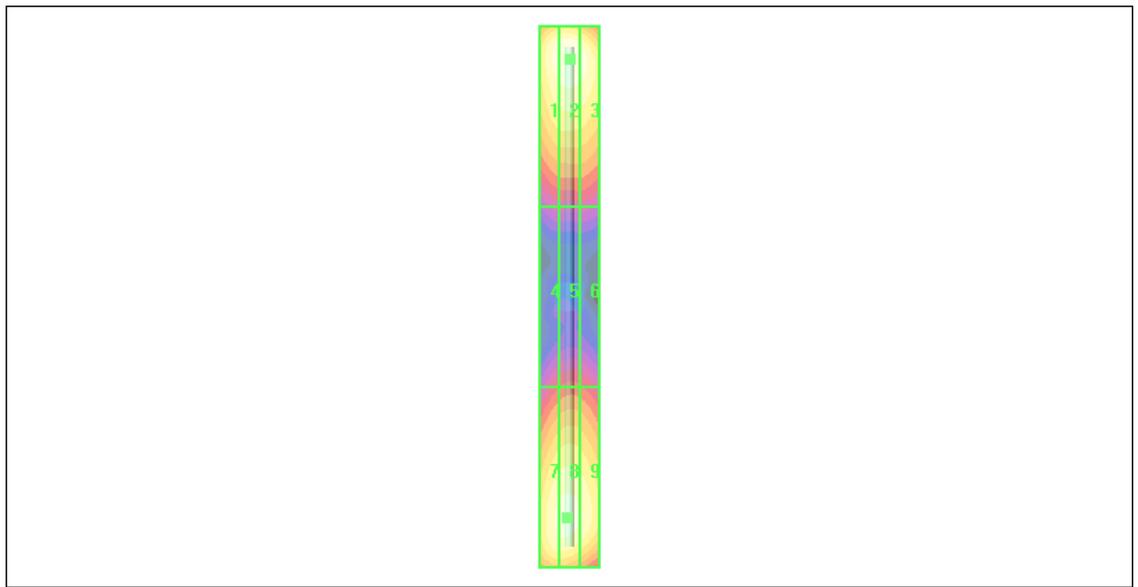
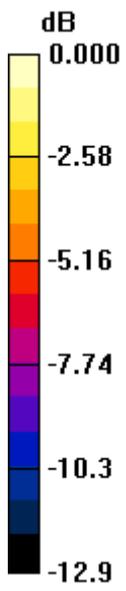
Device Reference Point: 0.000, 0.000, 353.7 mm

Reference Value = 62.8 V/m; Power Drift = -0.011 dB

Average Xclue of Total'=(187.4 + 177.6) / 2 = 182.5 V/m

Peak E-field in V/m

Grid 1 181.8 M4	Grid 2 187.4 M4	Grid 3 180.9 M4
Grid 4 93.5 M4	Grid 5 98.2 M4	Grid 6 96.0 M4
Grid 7 174.5 M4	Grid 8 177.6 M4	Grid 9 172.0 M4



0 dB = 187.4V/m

HAC_E_Dipole_1880_100129

DUT: HAC Dipole 1880 MHz

Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.4 °C

DASY4 Configuration:

- Probe: ER3DV6 - SN2302; ConvF(1, 1, 1); Calibrated: 2009/6/23
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

E Scan - ER probe center 10mm above CD1880 Dipole/Hearing Aid Compatibility

Test (41x181x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 156.2 V/m

Probe Modulation Factor = 1.00

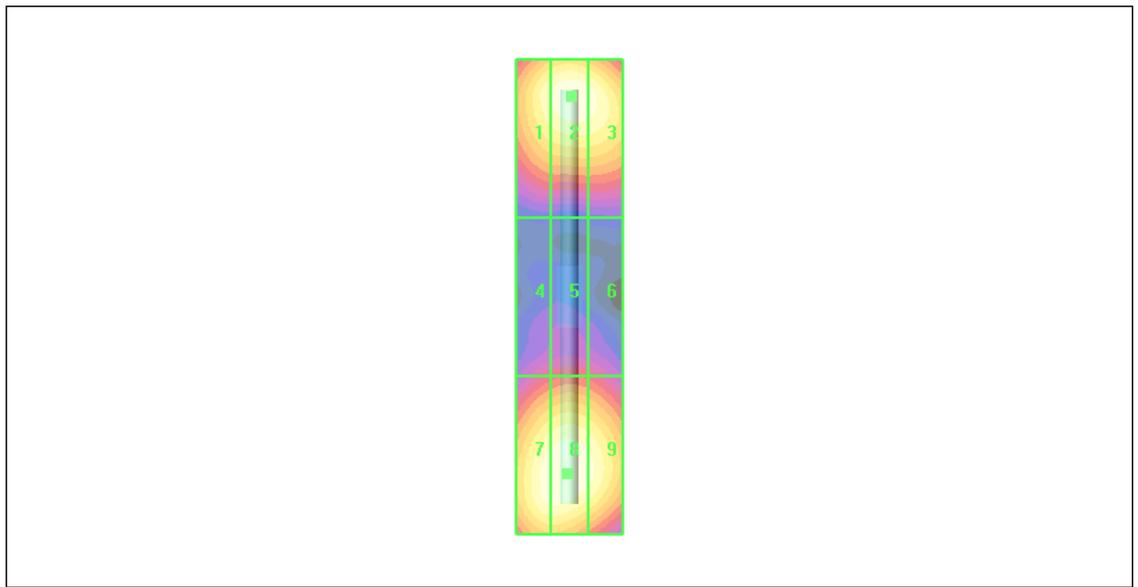
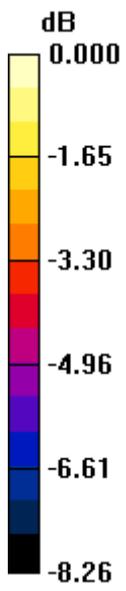
Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 76.9 V/m; Power Drift = 0.004 dB

Average Value of Total = (156.1 + 156.2) / 2 = 156.15 V/m

Peak E-field in V/m

Grid 1 147.4 M2	Grid 2 156.1 M2	Grid 3 152.3 M2
Grid 4 97.4 M3	Grid 5 101.3 M3	Grid 6 98.1 M3
Grid 7 154.0 M2	Grid 8 156.2 M2	Grid 9 150.5 M2



0 dB = 156.2V/m

HAC_H_Dipole_835MHz_100129

DUT: HAC-Dipole 835 MHz

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.6 °C

DASY4 Configuration:

- Probe: H3DV6 - SN6187; ; Calibrated: 2009/6/24
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

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 = 0.403 A/m

Probe Modulation Factor = 1.00

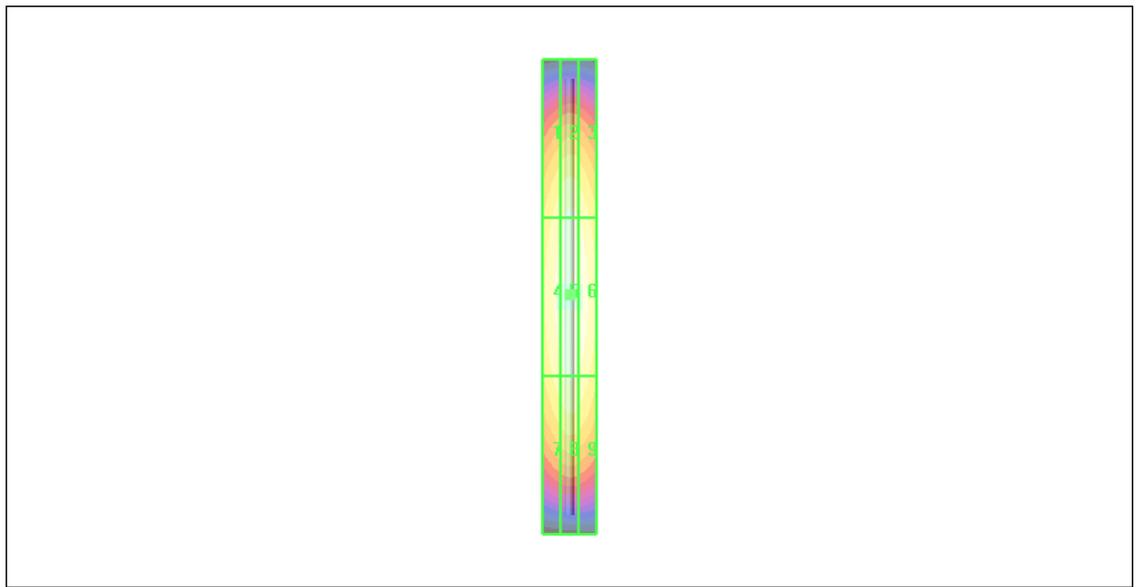
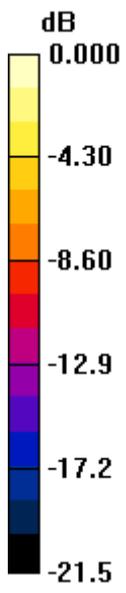
Device Reference Point: 0.000, 0.000, 354.7 mm

Reference Value = 0.350 A/m; Power Drift = -0.255 dB

Maximum Value of Total = 0.403 A/m

Peak H-field in A/m

Grid 1 0.326 M4	Grid 2 0.356 M4	Grid 3 0.339 M4
Grid 4 0.370 M4	Grid 5 0.403 M4	Grid 6 0.386 M4
Grid 7 0.323 M4	Grid 8 0.350 M4	Grid 9 0.335 M4



0 dB = 0.403A/m

HAC_H_Dipole_1880MHz_100129

DUT: HAC Dipole 1880 MHz

Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.6 °C

DASY4 Configuration:

- Probe: H3DV6 - SN6187; ; Calibrated: 2009/6/24
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

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 = 0.529 A/m

Probe Modulation Factor = 1.00

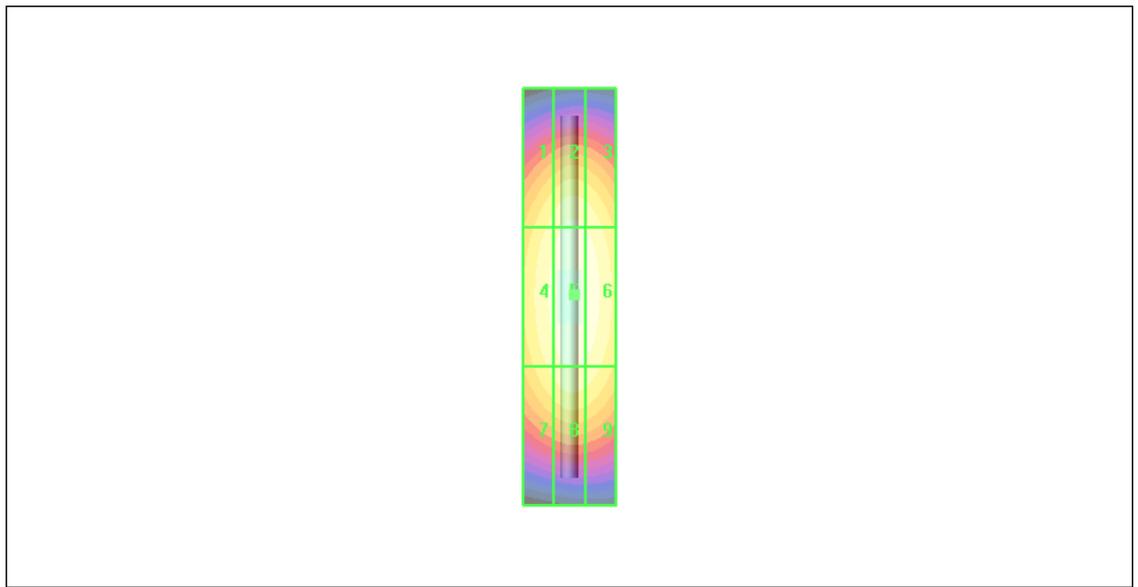
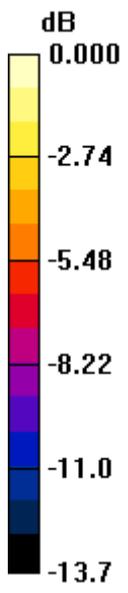
Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 0.178 A/m; Power Drift = -0.026 dB

Maximum Value of Total = 0.529 A/m

Peak H-field in A/m

Grid 1 0.452 M2	Grid 2 0.490 M2	Grid 3 0.476 M2
Grid 4 0.492 M2	Grid 5 0.529 M2	Grid 6 0.515 M2
Grid 7 0.447 M2	Grid 8 0.481 M2	Grid 9 0.467 M2



0 dB = 0.529A/m



Appendix B. Plots of RF Emission Measurement

The plots are shown as follows.

#02 HAC_E_CDMA2000 BC0_RC1 SO3 Voice_Ch384_Slide Up

DUT: 011407

Communication System: CDMA ; Frequency: 836.52 MHz;Duty Cycle: 1:1
 Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³
 Ambient Temperature : 22.5 °C

DASY4 Configuration:

- Probe: ER3DV6 - SN2302; ConvF(1, 1, 1); Calibrated: 2009/6/23
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch384/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 82.0 V/m

Probe Modulation Factor = 2.89

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 35.4 V/m; Power Drift = 0.105 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

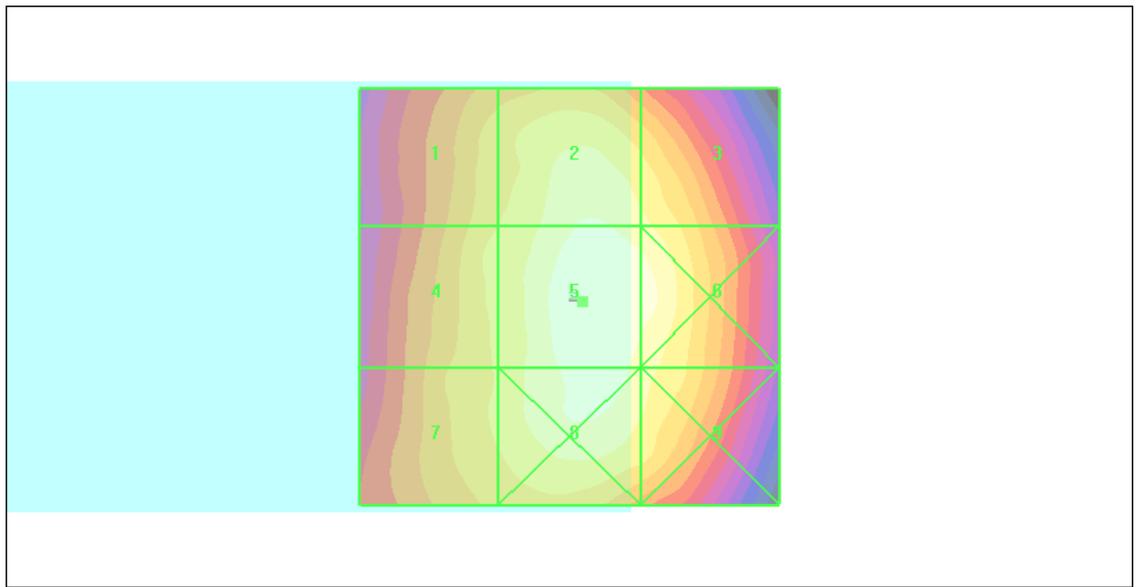
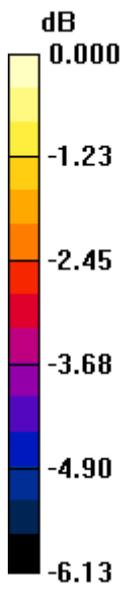
Grid 1 71.3 M4	Grid 2 78.6 M4	Grid 3 76.0 M4
Grid 4 72.8 M4	Grid 5 82.0 M4	Grid 6 80.2 M4
Grid 7 72.1 M4	Grid 8 80.3 M4	Grid 9 76.8 M4

Cursor:

Total = 82.0 V/m

E Category: M4

Location: -1.5, 0.5, 8.7 mm



0 dB = 82.0V/m

#01 HAC_E_CDMA2000 BC0_RC1 SO3 Voice_Ch384_Slide Off

DUT: 011407

Communication System: CDMA ; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³
Ambient Temperature : 22.6 °C

DASY4 Configuration:

- Probe: ER3DV6 - SN2302; ConvF(1, 1, 1); Calibrated: 2009/6/23
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch384/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 64.8 V/m

Probe Modulation Factor = 2.89

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 28.9 V/m; Power Drift = -0.252 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

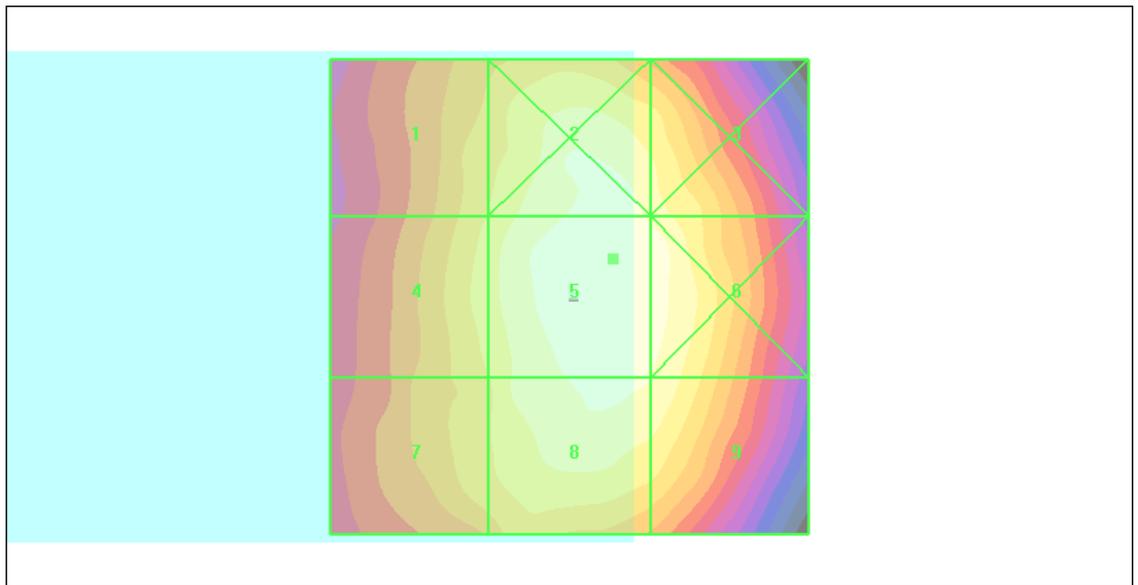
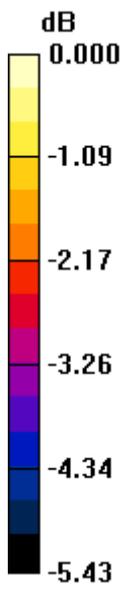
Grid 1 57.4 M4	Grid 2 64.0 M4	Grid 3 61.6 M4
Grid 4 58.7 M4	Grid 5 64.8 M4	Grid 6 63.7 M4
Grid 7 57.1 M4	Grid 8 63.0 M4	Grid 9 62.2 M4

Cursor:

Total = 64.8 V/m

E Category: M4

Location: -4.5, -4, 8.7 mm



0 dB = 64.8V/m

#03 HAC_E_CDMA2000 BC0_RC1 SO3 Voice_Ch1013_Slide Up

DUT: 011407

Communication System: CDMA ; Frequency: 824.7 MHz;Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.6 °C

DASY4 Configuration:

- Probe: ER3DV6 - SN2302; ConvF(1, 1, 1); Calibrated: 2009/6/23
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch1013/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 69.4 V/m

Probe Modulation Factor = 2.89

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 30.1 V/m; Power Drift = -0.042 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

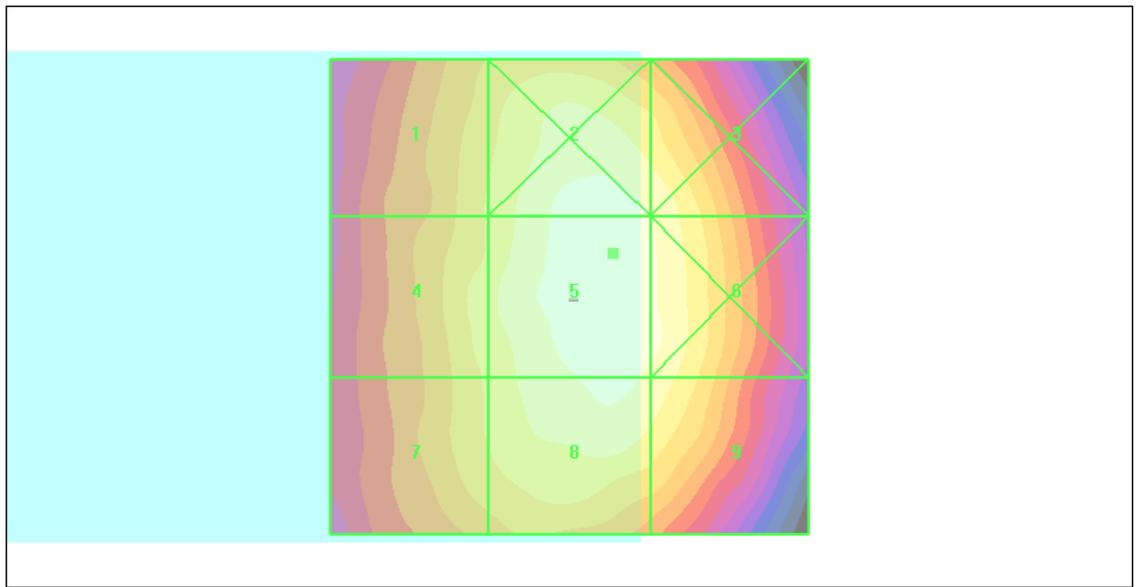
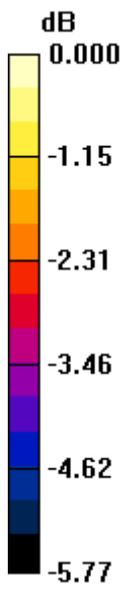
Grid 1 61.1 M4	Grid 2 68.2 M4	Grid 3 66.5 M4
Grid 4 62.7 M4	Grid 5 69.4 M4	Grid 6 67.1 M4
Grid 7 61.4 M4	Grid 8 67.3 M4	Grid 9 65.8 M4

Cursor:

Total = 69.4 V/m

E Category: M4

Location: -4.5, -4.5, 8.7 mm



0 dB = 69.4V/m

#04 HAC_E_CDMA2000 BC0_RC1 SO3 Voice_Ch777_Slide Up

DUT: 011407

Communication System: CDMA ; Frequency: 848.31 MHz;Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.6 °C

DASY4 Configuration:

- Probe: ER3DV6 - SN2302; ConvF(1, 1, 1); Calibrated: 2009/6/23
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch777/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 78.9 V/m

Probe Modulation Factor = 2.89

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 34.1 V/m; Power Drift = 0.020 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

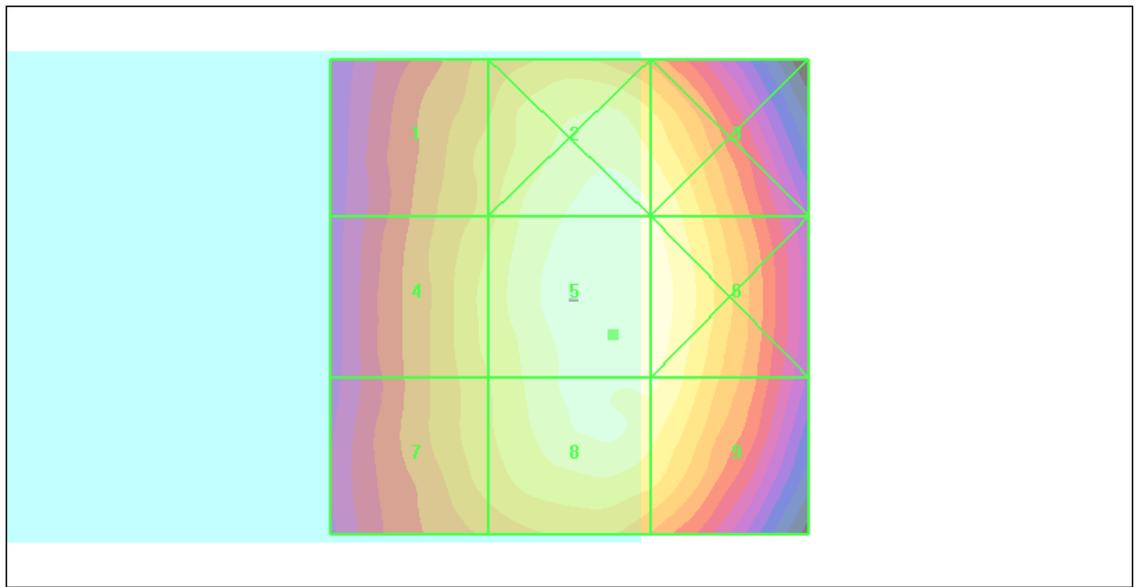
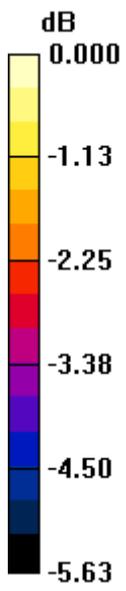
Grid 1 68.2 M4	Grid 2 77.7 M4	Grid 3 76.2 M4
Grid 4 70.6 M4	Grid 5 78.9 M4	Grid 6 77.8 M4
Grid 7 69.3 M4	Grid 8 76.7 M4	Grid 9 76.1 M4

Cursor:

Total = 78.9 V/m

E Category: M4

Location: -4.5, 4, 8.7 mm



0 dB = 78.9V/m

#09 HAC_E_CDMA2000 BC1_RC1 SO3 Voice_Ch600_Slide Off

DUT: 011407

Communication System: CDMA ; Frequency: 1880 MHz;Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.6 °C

DASY4 Configuration:

- Probe: ER3DV6 - SN2302; ConvF(1, 1, 1); Calibrated: 2009/6/23
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch600/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 37.3 V/m

Probe Modulation Factor = 3.08

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 10.5 V/m; Power Drift = -0.097 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

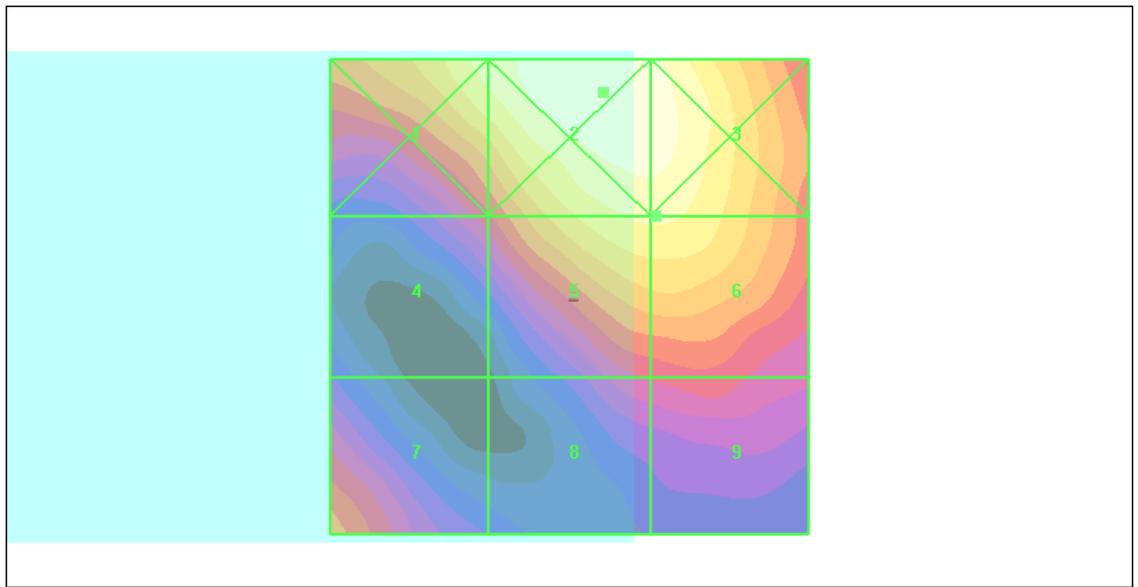
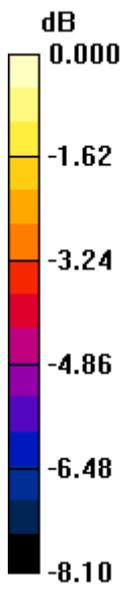
Grid 1 37.9 M4	Grid 2 41.6 M4	Grid 3 40.5 M4
Grid 4 26.6 M4	Grid 5 37.3 M4	Grid 6 37.3 M4
Grid 7 29.8 M4	Grid 8 25.6 M4	Grid 9 26.5 M4

Cursor:

Total = 41.6 V/m

E Category: M4

Location: -3.5, -21.5, 8.7 mm



0 dB = 41.6V/m

#10 HAC_E_CDMA2000 BC1_RC1 SO3 Voice_Ch600_Slide Up

DUT: 011407

Communication System: CDMA ; Frequency: 1880 MHz;Duty Cycle: 1:1
 Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³
 Ambient Temperature : 22.5 °C

DASY4 Configuration:

- Probe: ER3DV6 - SN2302; ConvF(1, 1, 1); Calibrated: 2009/6/23
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch600/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 33.5 V/m

Probe Modulation Factor = 3.08

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 9.63 V/m; Power Drift = -0.044 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

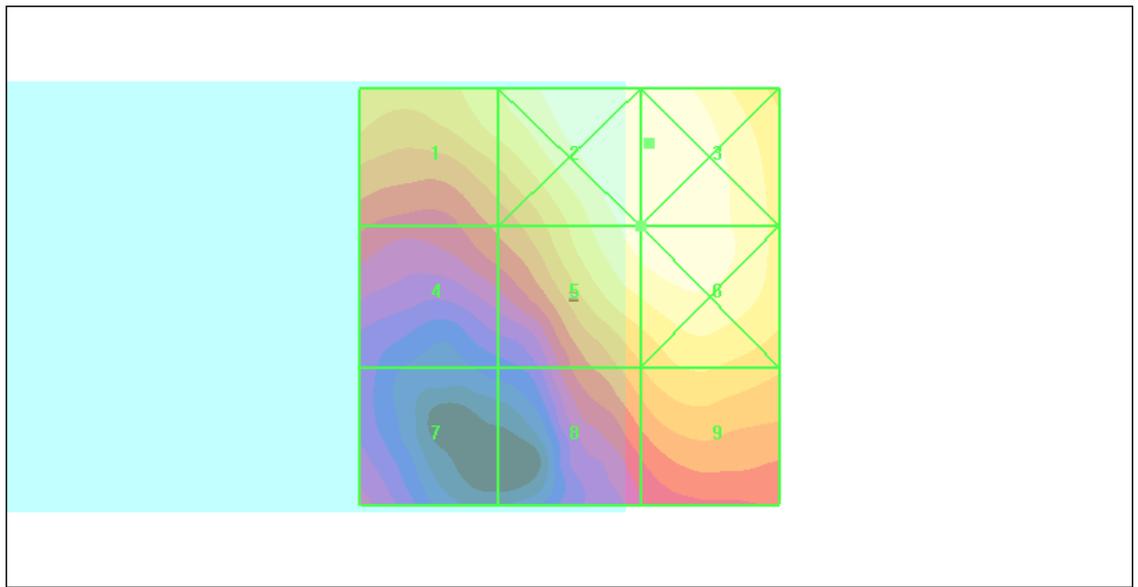
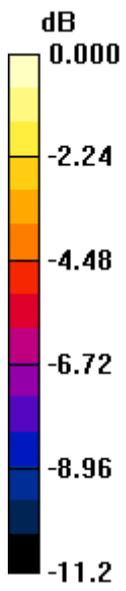
Grid 1 29.0 M4	Grid 2 34.9 M4	Grid 3 34.9 M4
Grid 4 21.3 M4	Grid 5 33.5 M4	Grid 6 34.4 M4
Grid 7 16.9 M4	Grid 8 24.6 M4	Grid 9 27.3 M4

Cursor:

Total = 34.9 V/m

E Category: M4

Location: -9.5, -18.5, 8.7 mm



0 dB = 34.9V/m

#11 HAC_E_CDMA2000 BC1_RC1 SO3 Voice_Ch25_Slide Off

DUT: 011407

Communication System: CDMA ; Frequency: 1851.25 MHz;Duty Cycle: 1:1
 Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³
 Ambient Temperature : 22.4 °C

DASY4 Configuration:

- Probe: ER3DV6 - SN2302; ConvF(1, 1, 1); Calibrated: 2009/6/23
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch25/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 48.0 V/m

Probe Modulation Factor = 3.08

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 14.6 V/m; Power Drift = -0.019 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

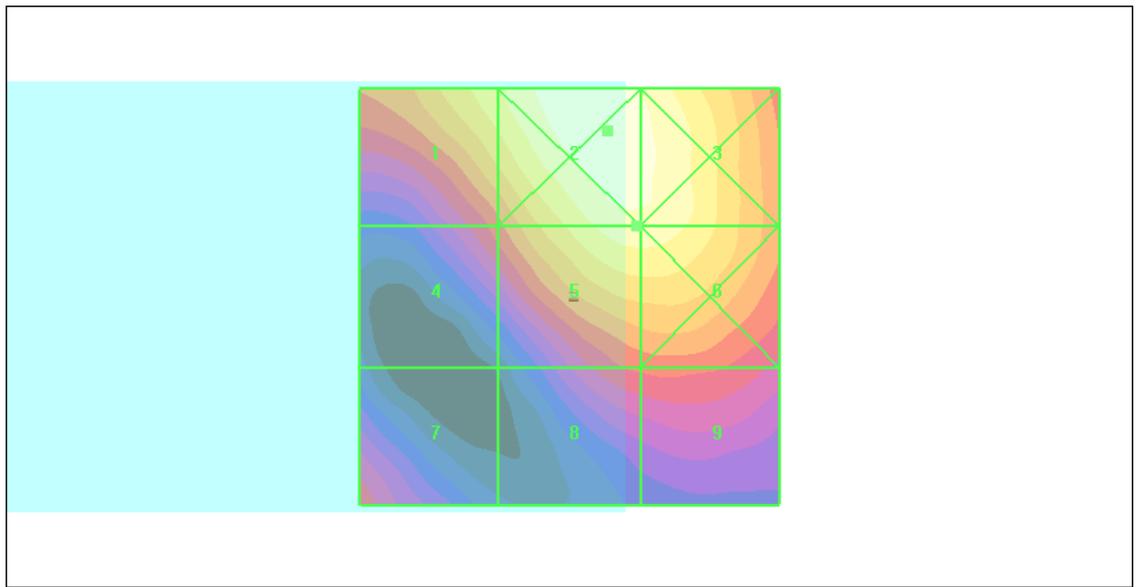
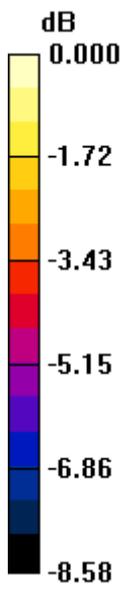
Grid 1 45.8 M4	Grid 2 52.5 M4	Grid 3 50.3 M4
Grid 4 34.6 M4	Grid 5 48.0 M4	Grid 6 48.0 M4
Grid 7 32.8 M4	Grid 8 33.7 M4	Grid 9 34.2 M4

Cursor:

Total = 52.5 V/m

E Category: M4

Location: -4.5, -20, 8.7 mm



0 dB = 52.5V/m

#12 HAC_E_CDMA2000 BC1_RC1 SO3 Voice_Ch1175_Slide Off

DUT: 011407

Communication System: CDMA ; Frequency: 1908.75 MHz;Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.5 °C

DASY4 Configuration:

- Probe: ER3DV6 - SN2302; ConvF(1, 1, 1); Calibrated: 2009/6/23
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

CH1175/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 44.2 V/m

Probe Modulation Factor = 3.08

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 12.7 V/m; Power Drift = -0.138 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

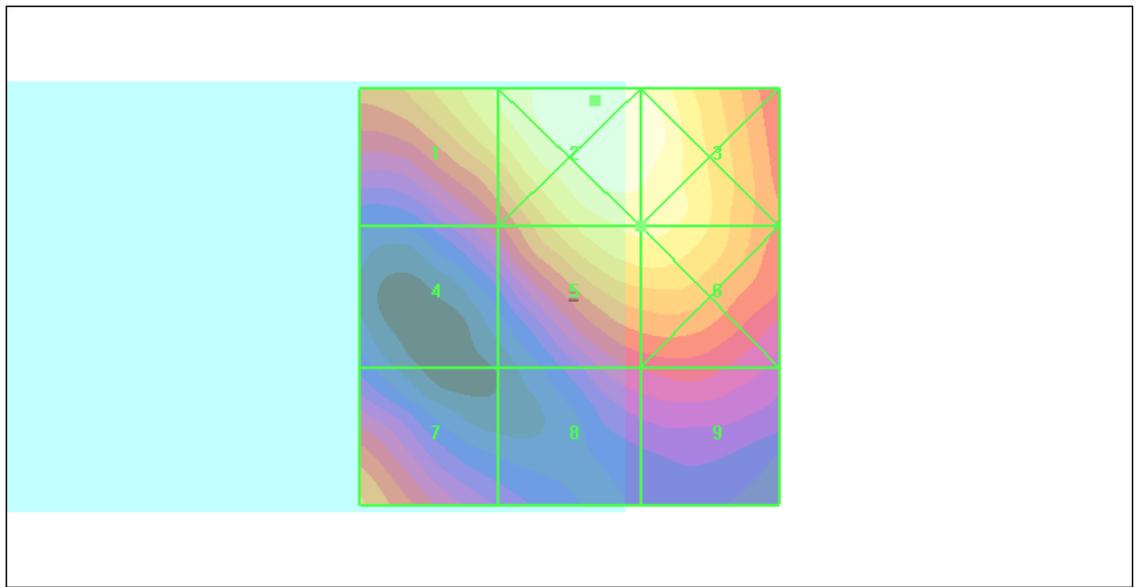
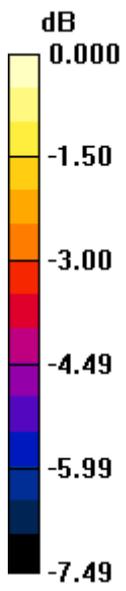
Grid 1 44.0 M4	Grid 2 48.8 M4	Grid 3 48.2 M4
Grid 4 32.1 M4	Grid 5 44.2 M4	Grid 6 44.2 M4
Grid 7 37.1 M4	Grid 8 31.2 M4	Grid 9 32.0 M4

Cursor:

Total = 48.8 V/m

E Category: M4

Location: -3, -23.5, 8.7 mm



0 dB = 48.8V/m

#17 HAC_H_CDMA2000 BC0_RC1 SO3 Voice_Ch384_Slide Off

DUT: 011407

Communication System: CDMA ; Frequency: 836.52 MHz;Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.5 °C

DASY4 Configuration:

- Probe: H3DV6 - SN6187; ; Calibrated: 2009/6/24
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch384/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.103 A/m

Probe Modulation Factor = 2.70

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 0.021 A/m; Power Drift = 0.127 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

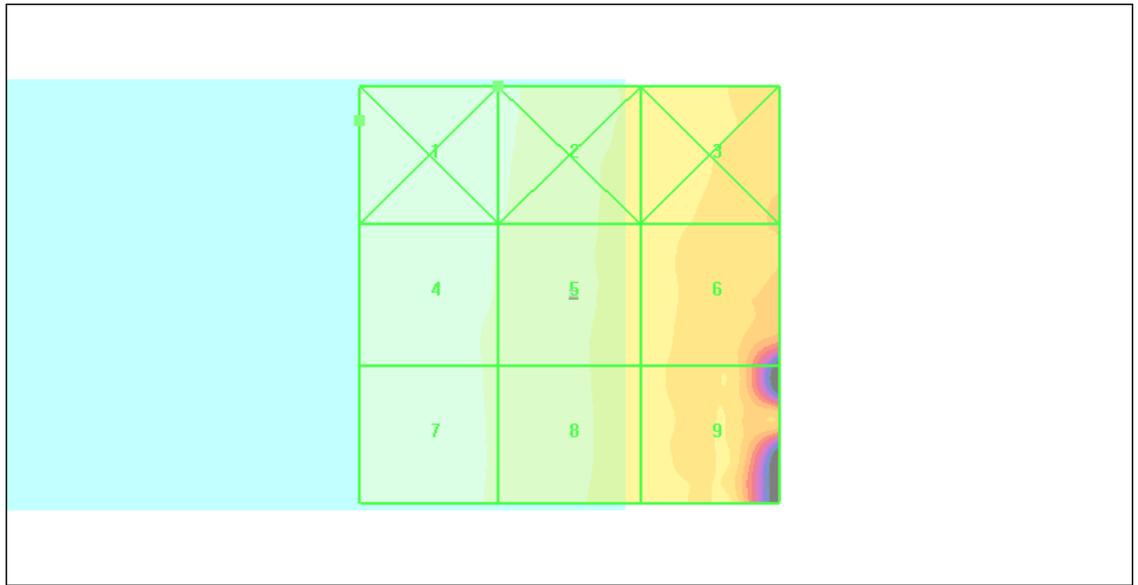
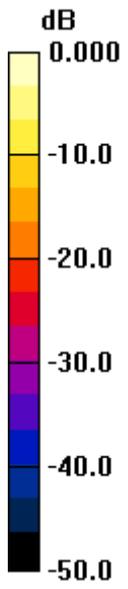
Grid 1 0.108 M4	Grid 2 0.080 M4	Grid 3 0.048 M4
Grid 4 0.103 M4	Grid 5 0.075 M4	Grid 6 0.045 M4
Grid 7 0.100 M4	Grid 8 0.071 M4	Grid 9 0.044 M4

Cursor:

Total = 0.108 A/m

H Category: M4

Location: 25, -21, 8.7 mm



0 dB = 0.108A/m

#18 HAC_H_CDMA2000 BC0_RC1 SO3 Voice_Ch384_Slide Up

DUT: 011407

Communication System: CDMA ; Frequency: 836.52 MHz;Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.5 °C

DASY4 Configuration:

- Probe: H3DV6 - SN6187; ; Calibrated: 2009/6/24
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch384/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.133 A/m

Probe Modulation Factor = 2.70

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 0.026 A/m; Power Drift = 0.127 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

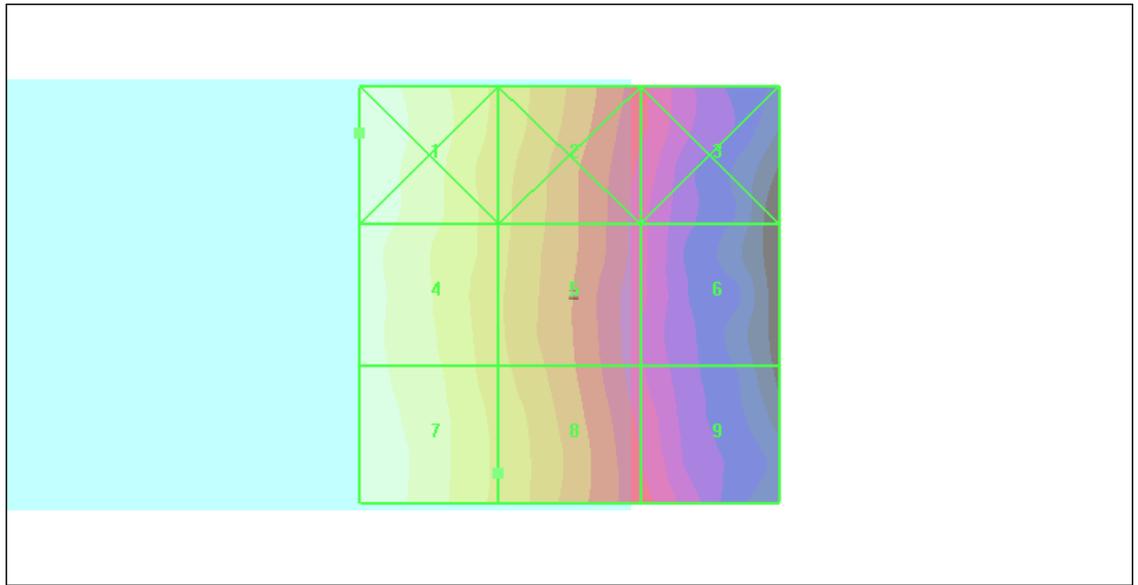
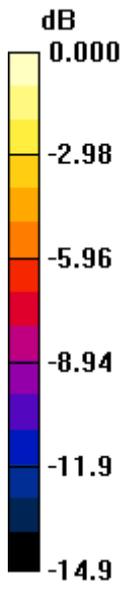
Grid 1 0.135 M4	Grid 2 0.094 M4	Grid 3 0.056 M4
Grid 4 0.129 M4	Grid 5 0.090 M4	Grid 6 0.051 M4
Grid 7 0.133 M4	Grid 8 0.094 M4	Grid 9 0.057 M4

Cursor:

Total = 0.135 A/m

H Category: M4

Location: 25, -19.5, 8.7 mm



0 dB = 0.135A/m

#19 HAC_H_CDMA2000 BC0_RC1 SO3 Voice_Ch1013_Slide Up

DUT: 011407

Communication System: CDMA ; Frequency: 824.7 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.5 °C

DASY4 Configuration:

- Probe: H3DV6 - SN6187; ; Calibrated: 2009/6/24
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch1013/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.108 A/m

Probe Modulation Factor = 2.70

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 0.020 A/m; Power Drift = -0.003 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

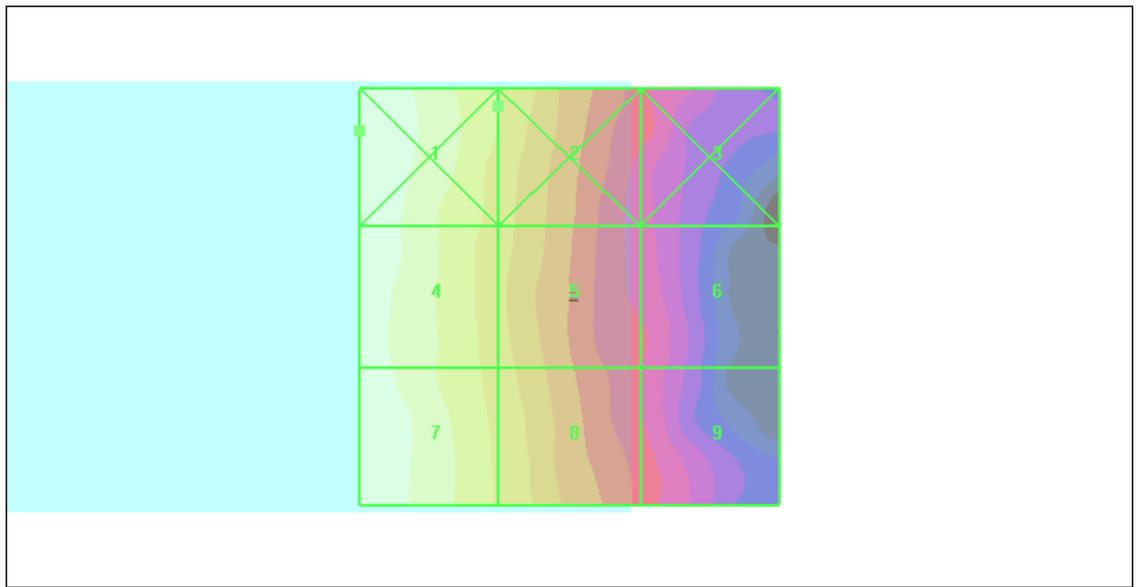
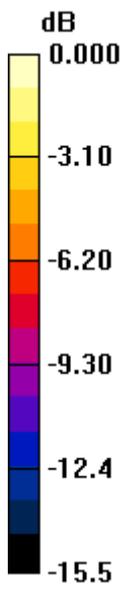
Grid 1 0.109 M4	Grid 2 0.077 M4	Grid 3 0.044 M4
Grid 4 0.104 M4	Grid 5 0.072 M4	Grid 6 0.043 M4
Grid 7 0.108 M4	Grid 8 0.075 M4	Grid 9 0.046 M4

Cursor:

Total = 0.109 A/m

H Category: M4

Location: 25, -20, 8.7 mm



0 dB = 0.109A/m

#20 HAC_H_CDMA2000 BC0_RC1 SO3 Voice_Ch777_Slide Up

DUT: 011407

Communication System: CDMA ; Frequency: 848.31 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.6 °C

DASY4 Configuration:

- Probe: H3DV6 - SN6187; ; Calibrated: 2009/6/24
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch777/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.129 A/m

Probe Modulation Factor = 2.70

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 0.024 A/m; Power Drift = 0.221 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

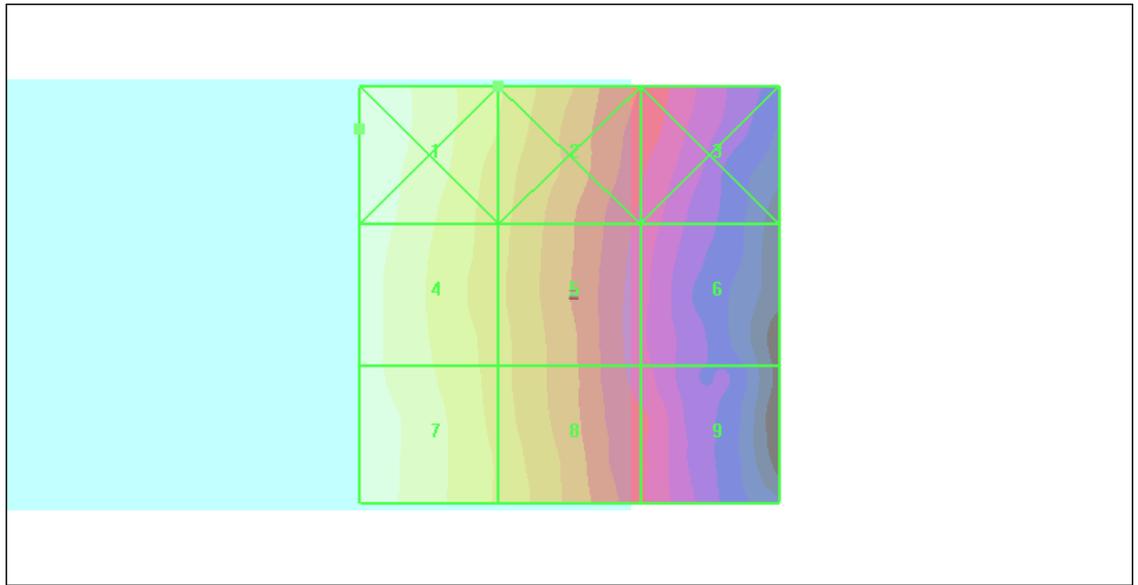
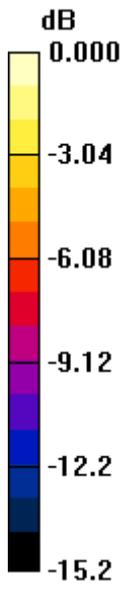
Grid 1 0.131 M4	Grid 2 0.094 M4	Grid 3 0.058 M4
Grid 4 0.126 M4	Grid 5 0.087 M4	Grid 6 0.050 M4
Grid 7 0.129 M4	Grid 8 0.091 M4	Grid 9 0.053 M4

Cursor:

Total = 0.131 A/m

H Category: M4

Location: 25, -20, 8.7 mm



0 dB = 0.131A/m

#25 HAC_H_CDMA2000 BC1_RC1 SO3 Voice_Ch600_Slide Off

DUT: 011407

Communication System: CDMA ; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.5 °C

DASY4 Configuration:

- Probe: H3DV6 - SN6187; ; Calibrated: 2009/6/24
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch600/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.096 A/m

Probe Modulation Factor = 2.70

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 0.033 A/m; Power Drift = 0.077 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

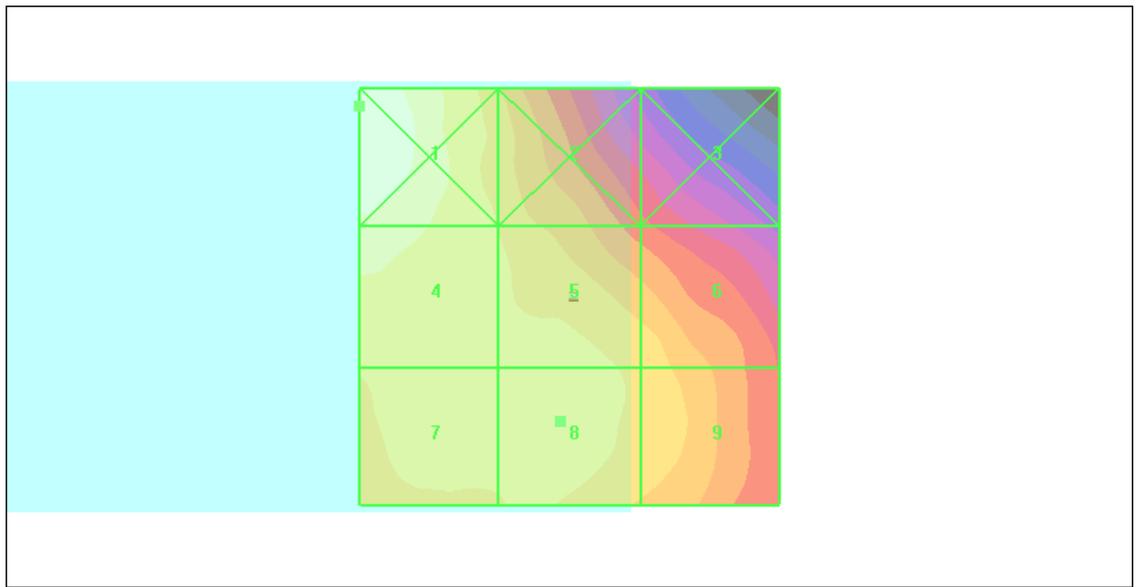
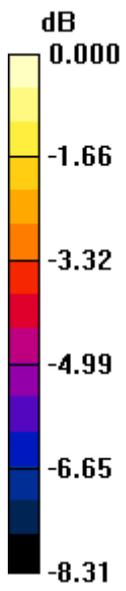
Grid 1 0.103 M4	Grid 2 0.085 M4	Grid 3 0.068 M4
Grid 4 0.096 M4	Grid 5 0.088 M4	Grid 6 0.083 M4
Grid 7 0.089 M4	Grid 8 0.089 M4	Grid 9 0.084 M4

Cursor:

Total = 0.103 A/m

H Category: M4

Location: 25, -23, 8.7 mm



0 dB = 0.103A/m

#26 HAC_H_CDMA2000 BC1_RC1 SO3 Voice_Ch600_Slide Up

DUT: 011407

Communication System: CDMA ; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.6 °C

DASY4 Configuration:

- Probe: H3DV6 - SN6187; ; Calibrated: 2009/6/24
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch600/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.064 A/m

Probe Modulation Factor = 2.70

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 0.019 A/m; Power Drift = -0.003 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

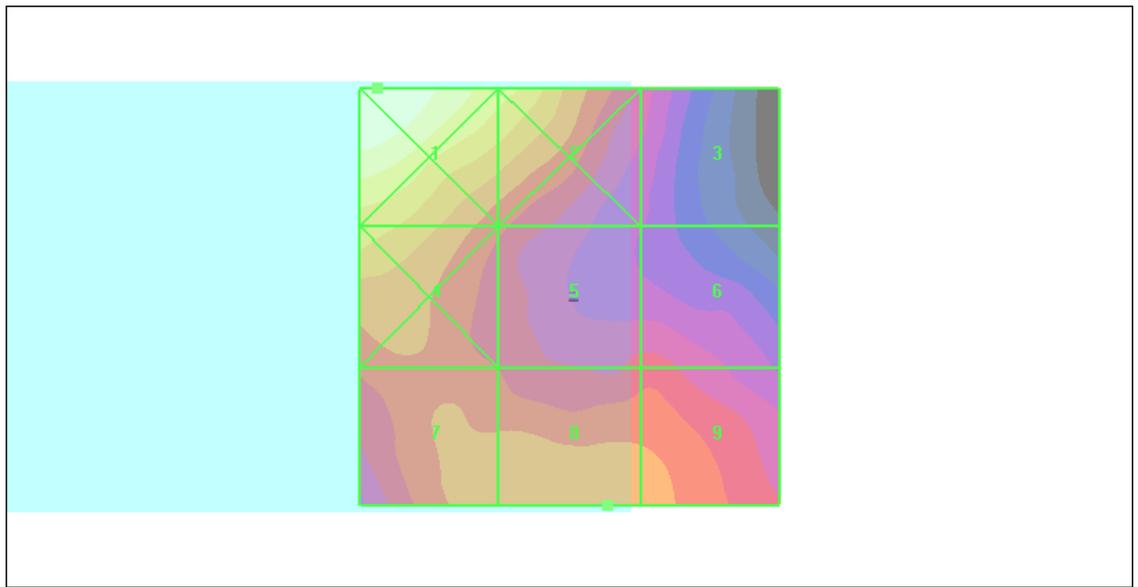
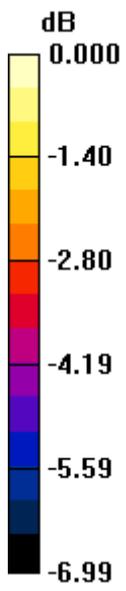
Grid 1 0.084 M4	Grid 2 0.073 M4	Grid 3 0.054 M4
Grid 4 0.070 M4	Grid 5 0.059 M4	Grid 6 0.056 M4
Grid 7 0.064 M4	Grid 8 0.064 M4	Grid 9 0.064 M4

Cursor:

Total = 0.084 A/m

H Category: M4

Location: 23, -25, 8.7 mm



0 dB = 0.084A/m

#27 HAC_H_CDMA2000 BC1_RC1 SO3 Voice_Ch25_Slide Off

DUT: 011407

Communication System: CDMA ; Frequency: 1851.25 MHz;Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.6 °C

DASY4 Configuration:

- Probe: H3DV6 - SN6187; ; Calibrated: 2009/6/24
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch25/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.114 A/m

Probe Modulation Factor = 2.70

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 0.040 A/m; Power Drift = 0.038 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

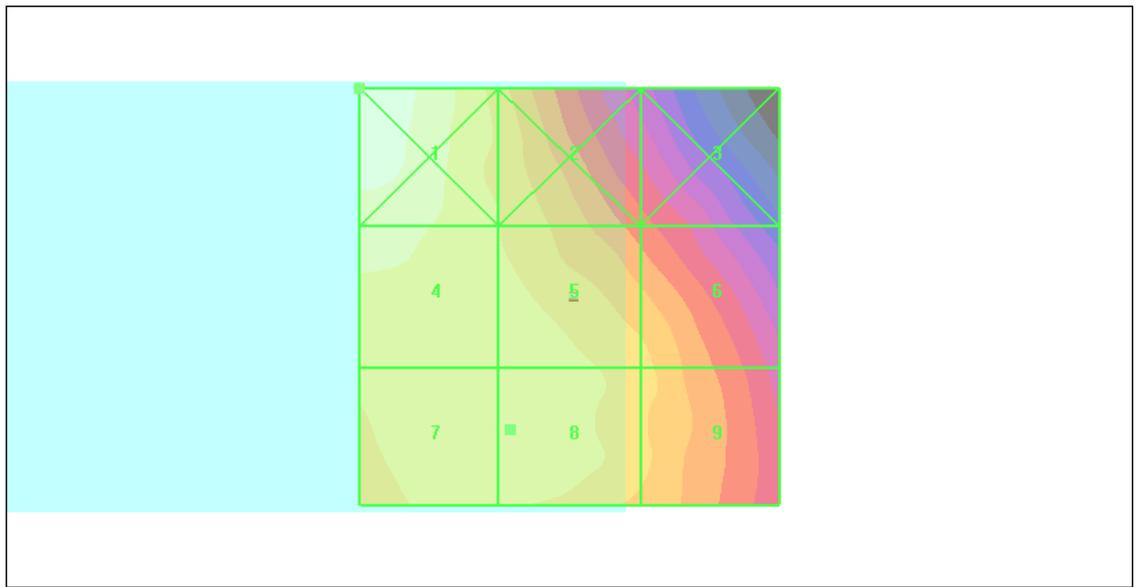
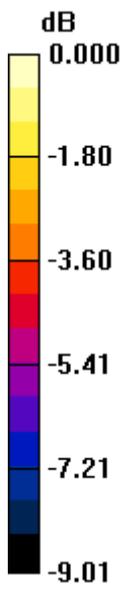
Grid 1 0.127 M4	Grid 2 0.104 M4	Grid 3 0.081 M4
Grid 4 0.114 M4	Grid 5 0.107 M4	Grid 6 0.099 M4
Grid 7 0.109 M4	Grid 8 0.109 M4	Grid 9 0.099 M4

Cursor:

Total = 0.127 A/m

H Category: M4

Location: 25, -25, 8.7 mm



0 dB = 0.127A/m

#28 HAC_H_CDMA2000 BC1_RC1 SO3 Voice_Ch1175_Slide Off

DUT: 011407

Communication System: CDMA ; Frequency: 1908.75 MHz;Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.6 °C

DASY4 Configuration:

- Probe: H3DV6 - SN6187; ; Calibrated: 2009/6/24
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn577; Calibrated: 2009/8/24
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch1175/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.103 A/m

Probe Modulation Factor = 2.70

Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 0.036 A/m; Power Drift = -0.094 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

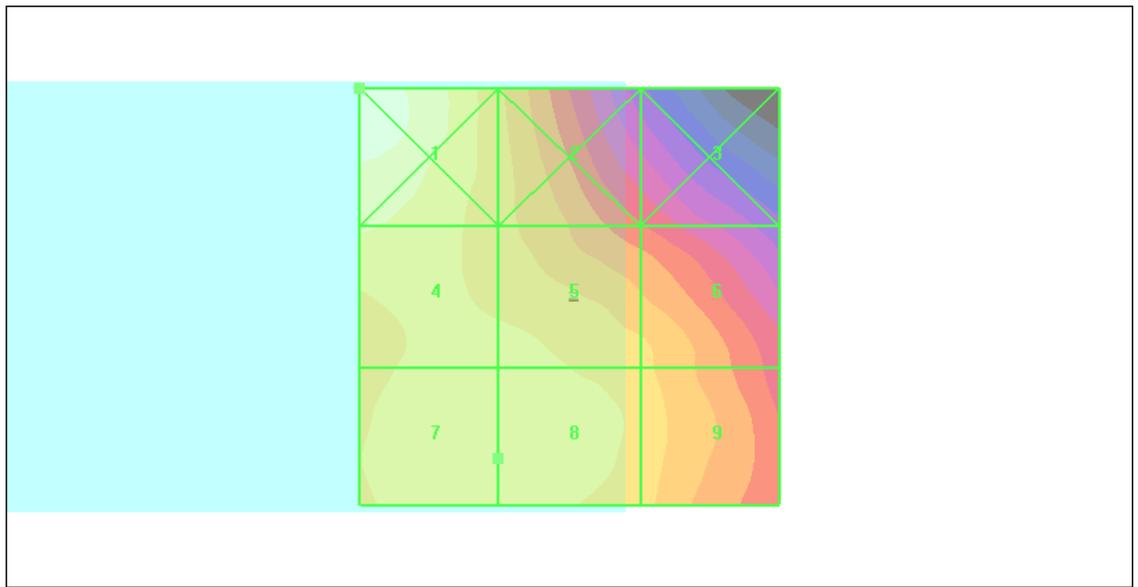
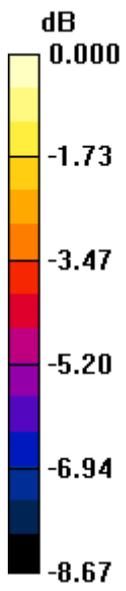
Grid 1 0.117 M4	Grid 2 0.092 M4	Grid 3 0.074 M4
Grid 4 0.103 M4	Grid 5 0.099 M4	Grid 6 0.091 M4
Grid 7 0.101 M4	Grid 8 0.101 M4	Grid 9 0.093 M4

Cursor:

Total = 0.117 A/m

H Category: M4

Location: 25, -25, 8.7 mm



0 dB = 0.117A/m



Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.



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



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

Accreditation No.: SCS 108

Client Sporton (Auden)

Certificate No: DAE3-577_Aug09

CALIBRATION CERTIFICATE

Object: DAE3 - SD 000 D03 AA - SN: 577
Calibration procedure(s): QA CAL-06.v20 Calibration procedure for the data acquisition electronics (DAE)
Calibration date: August 24, 2009
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)

Table with 4 columns: Standard Type, ID #, Date, and Check/Calibration status. Includes Keithley Multimeter Type 2001 and Calibrator Box V1.1.

Calibrated by: Name Andrea Guntli, Function Technician, Signature [Handwritten]

Approved by: Name Fin Bornholt, Function R&D Director, Signature [Handwritten]

Issued: August 24, 2009

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Accreditation No.: SCS 108

Glossary

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

Methods Applied and Interpretation of Parameters

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



DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 μ V , 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	404.338 \pm 0.1% (k=2)	403.798 \pm 0.1% (k=2)	404.230 \pm 0.1% (k=2)
Low Range	3.93524 \pm 0.7% (k=2)	3.93795 \pm 0.7% (k=2)	3.96031 \pm 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	236.5 \pm 1 $^{\circ}$
---	--------------------------



Appendix

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	200007.8	-2.29	-0.00
Channel X + Input	20001.53	1.43	0.01
Channel X - Input	-19993.95	5.05	-0.03
Channel Y + Input	200007.4	-1.77	-0.00
Channel Y + Input	19998.29	-1.61	-0.01
Channel Y - Input	-20001.65	-2.65	0.01
Channel Z + Input	200006.2	-2.31	-0.00
Channel Z + Input	20001.48	1.58	0.01
Channel Z - Input	-20000.84	0.01	0.01

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	1999.2	-0.90	-0.05
Channel X + Input	199.29	-0.81	-0.41
Channel X - Input	-201.77	-1.87	0.94
Channel Y + Input	2001.2	1.28	0.06
Channel Y + Input	198.17	-1.73	-0.86
Channel Y - Input	-201.74	-1.44	0.72
Channel Z + Input	1999.6	-0.38	-0.02
Channel Z + Input	198.12	-1.98	-0.99
Channel Z - Input	-202.47	-2.47	1.24

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	15.91	14.34
	- 200	-12.42	-13.97
Channel Y	200	-6.64	-6.80
	- 200	6.69	6.07
Channel Z	200	-1.25	-1.39
	- 200	-0.26	-0.28

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	1.37	0.39
Channel Y	200	1.76	-	3.65
Channel Z	200	2.33	-0.06	-



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	15967	16106
Channel Y	15858	15635
Channel Z	16203	16176

5. Input Offset Measurement

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

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	-0.02	-3.72	1.06	0.66
Channel Y	0.20	-1.12	1.38	0.41
Channel Z	-1.34	-2.07	-0.36	0.34

6. Input Offset Current

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

7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.1999	200.9
Channel Y	0.2000	201.5
Channel Z	0.1999	200.9

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

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

9. Power Consumption (verified during pre test)

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



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Accreditation No.: SCS 108

Client Auden

Certificate No: ER3-2302_Jun09

CALIBRATION CERTIFICATE

Object ER3DV6 - SN:2302
Calibration procedure(s) QA CAL-02.v5 Calibration procedure for E-field probes optimized for close near field evaluations in air
Calibration date: June 23, 2009
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)

Table with 4 columns: Primary Standards, ID #, Cal Date (Certificate No.), Scheduled Calibration. Lists equipment like Power meter E4419B, Power sensor E4412A, Reference 3 dB Attenuator, etc.

Table with 4 columns: Secondary Standards, ID #, Check Date (in house), Scheduled Check. Lists RF generator HP 8648C, Network Analyzer HP 8753E.

Calibrated by: Marcel Fehr, Laboratory Technician
Approved by: Katja Pokovic, Technical Manager

Issued: June 23, 2009

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Accreditation No.: SCS 108

Glossary:

NORM_{x,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., $\vartheta = 0$ is normal to probe axis
Connector Angle information used in DAS Y system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- *NORM_{x,y,z}*: Assessed for E-field polarization $\vartheta = 0$ for XY sensors and $\vartheta = 90$ for Z sensor ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide).
- *NORM(f)_{x,y,z}* = *NORM_{x,y,z}* * *frequency_response* (see Frequency Response Chart).
- *DCP_{x,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 *NORM_x* (no uncertainty required).



ER3DV6 SN:2302

June 23, 2009

Probe ER3DV6

SN:2302

Manufactured:	November 6, 2002
Last calibrated:	May 19, 2008
Recalibrated:	June 23, 2009

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)



ER3DV6 SN:2302

June 23, 2009

DASY - Parameters of Probe: ER3DV6 SN:2302

Sensitivity in Free Space [$\mu\text{V}/(\text{V}/\text{m})^2$]		Diode Compression [^]	
NormX	1.50 ± 10.1 % (k=2)	DCP X	93 mV
NormY	1.36 ± 10.1 % (k=2)	DCP Y	94 mV
NormZ	1.46 ± 10.1 % (k=2)	DCP Z	99 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 -3 °

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%.

[^] numerical linearization parameter: uncertainty not required

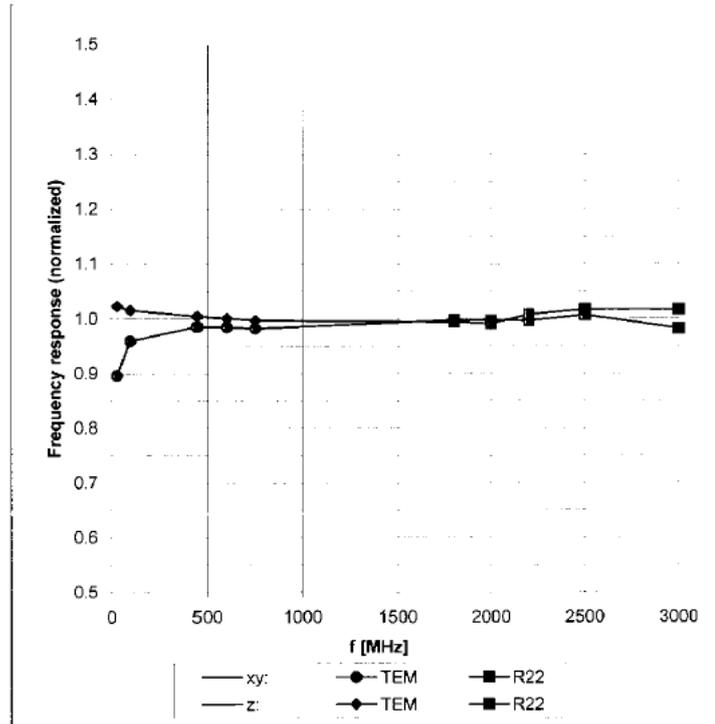


ER3DV6 SN:2302

June 23, 2009

Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide R22)

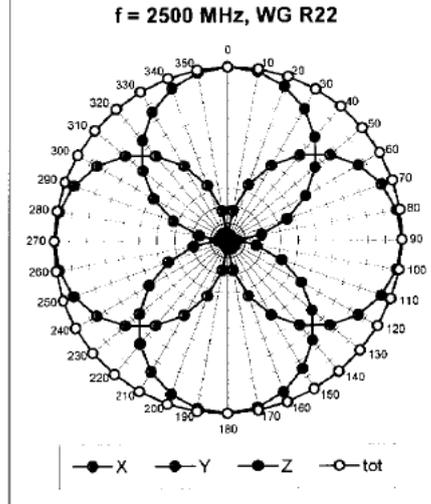
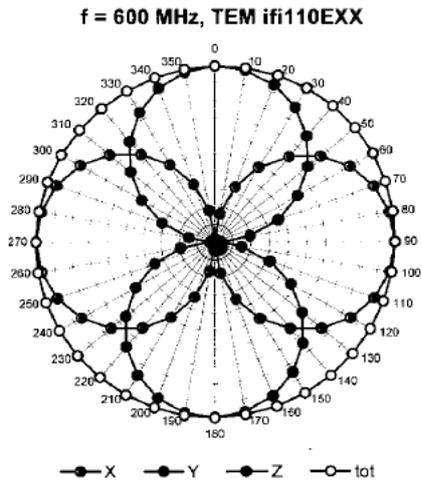


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

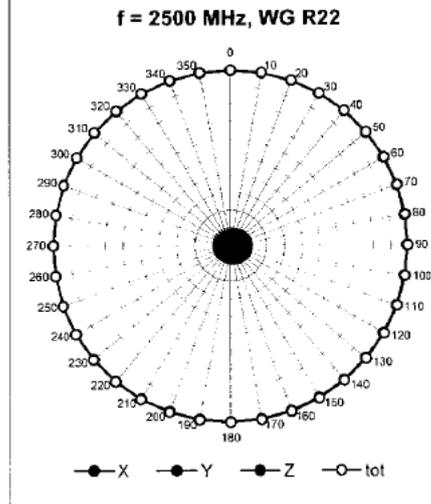
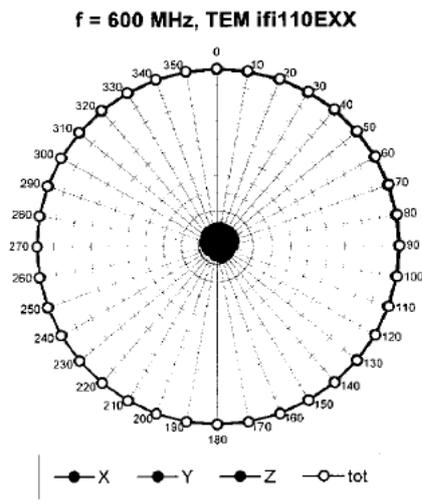
ER3DV6 SN:2302

June 23, 2009

Receiving Pattern (ϕ), $\vartheta = 0^\circ$



Receiving Pattern (ϕ), $\vartheta = 90^\circ$

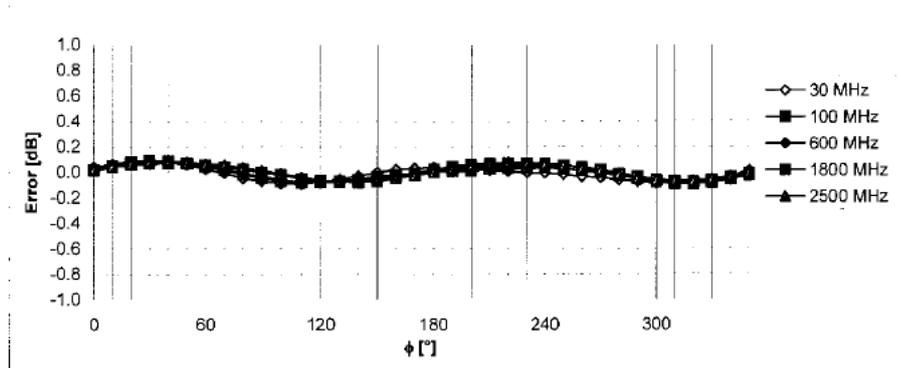




ER3DV6 SN:2302

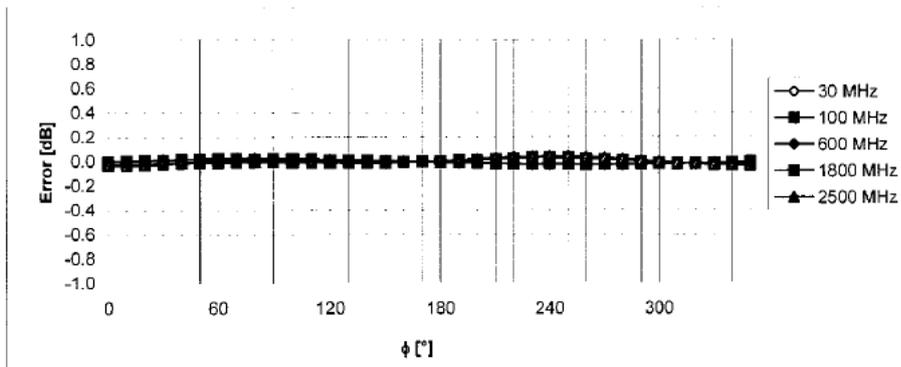
June 23, 2009

Receiving Pattern (ϕ), $\vartheta = 0^\circ$



Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

Receiving Pattern (ϕ), $\vartheta = 90^\circ$

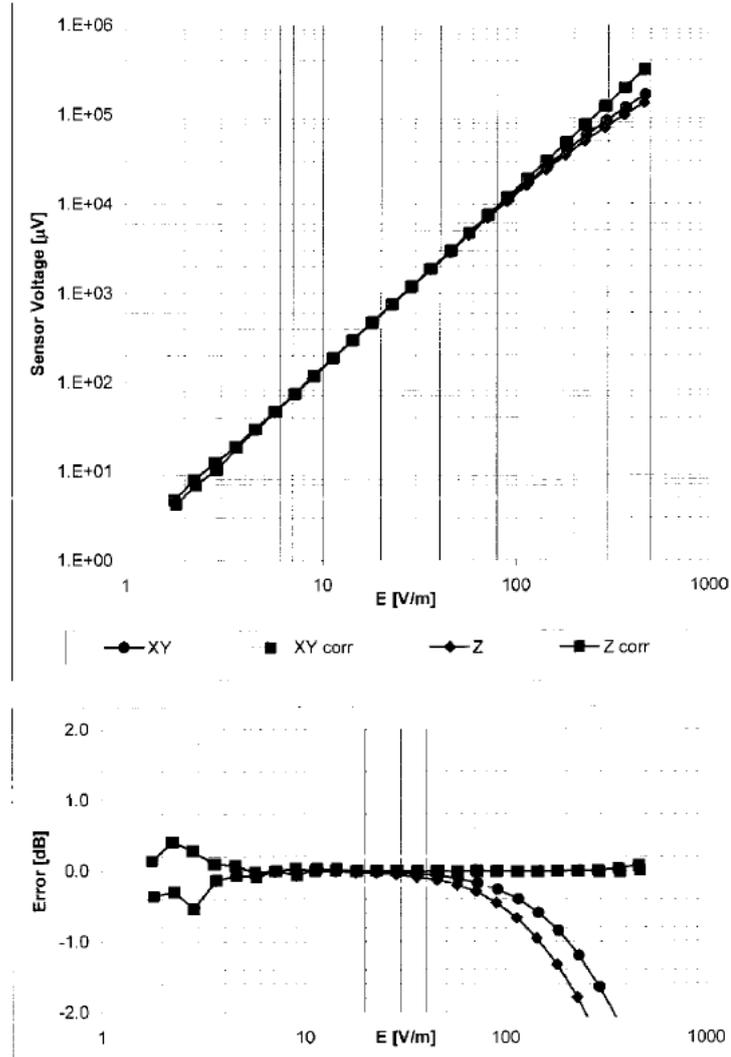


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

ER3DV6 SN:2302

June 23, 2009

Dynamic Range f(E-field) (Waveguide R22, f = 1800 MHz)



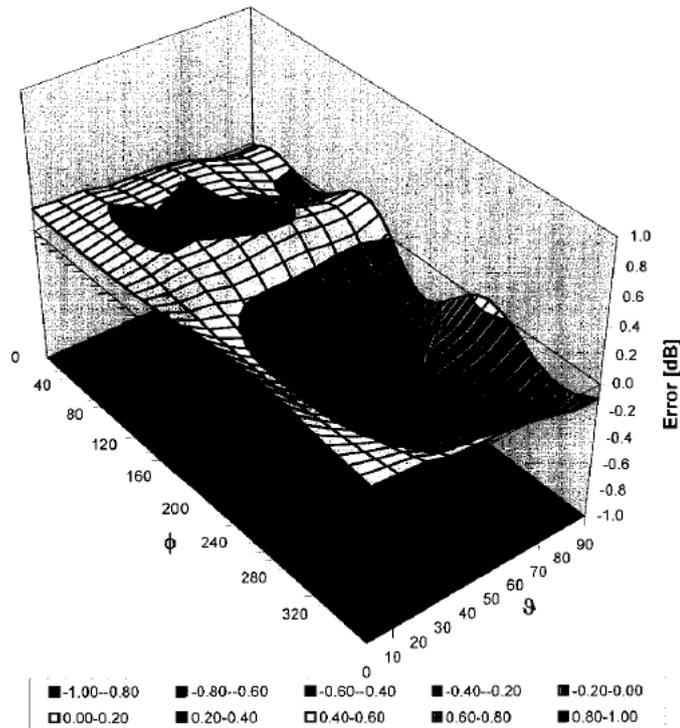
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)



ER3DV6 SN:2302

June 23, 2009

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



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)



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Accreditation No.: SCS 108

Client Auden

Certificate No: H3-6187_Jun09

CALIBRATION CERTIFICATE

Object H3DV6 - SN:6187
Calibration procedure(s) QA CAL-03.v5
Calibration procedure for H-field probes optimized for close near field evaluations in air
Calibration date: June 24, 2009
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)

Table with 4 columns: Primary Standards, ID #, Cal Date (Certificate No.), Scheduled Calibration. Lists various power meters, sensors, and attenuators with their respective IDs and calibration dates.

Table with 4 columns: Secondary Standards, ID #, Check Date (in house), Scheduled Check. Lists RF generator and Network Analyzer with their IDs and check dates.

Calibrated by: Marcel Fehr, Laboratory Technician
Approved by: Katja Pokovic, Technical Manager
Includes handwritten signatures for both individuals.

Issued: June 24, 2009

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Accreditation No.: **SCS 108**

Glossary:

NORM_{x,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., $\vartheta = 0$ is normal to probe axis
Connector Angle information used in DAS Y system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- X, Y, Z_{a0a1a2} : Assessed for E-field polarization $\vartheta = 90$ for XY sensors and $\vartheta = 0$ for Z sensor ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide).
- $X, Y, Z(f)_{a0a1a2} = X, Y, Z_{a0a1a2} \cdot \text{frequency_response}$ (see Frequency Response Chart).
- $DCP_{x,y,z}$: 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:6187

June 24, 2009

Probe H3DV6

SN:6187

Manufactured:	June 8, 2004
Last calibrated:	May 19, 2008
Recalibrated:	June 24, 2009

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)



H3DV6 SN:6187

June 24, 2009

DASY - Parameters of Probe: H3DV6 SN:6187

Sensitivity in Free Space [A/m / $\sqrt{(\mu\text{V})}$]

	a0	a1	a2
X	3.336E-03	-8.041E-5	3.177E-5 ± 5.1 % (k=2)
Y	2.531E-03	9.397E-6	1.979E-5 ± 5.1 % (k=2)
Z	3.120E-03	-1.434E-4	8.995E-5 ± 5.1 % (k=2)

Diode Compression¹

DCP X	98 mV
DCP Y	95 mV
DCP Z	84 mV

Sensor Offset (Probe Tip to Sensor Center)

X	3.0 mm
Y	3.0 mm
Z	3.0 mm

Connector Angle -116 °

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

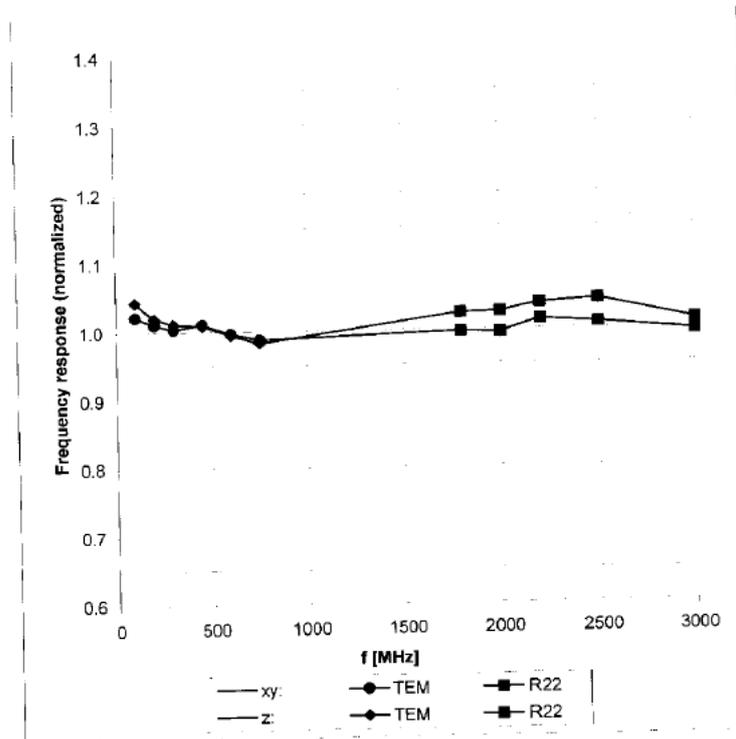


H3DV6 SN:6187

June 24, 2009

Frequency Response of H-Field

(TEM-Cell:ifi110 EXX, Waveguide R22)

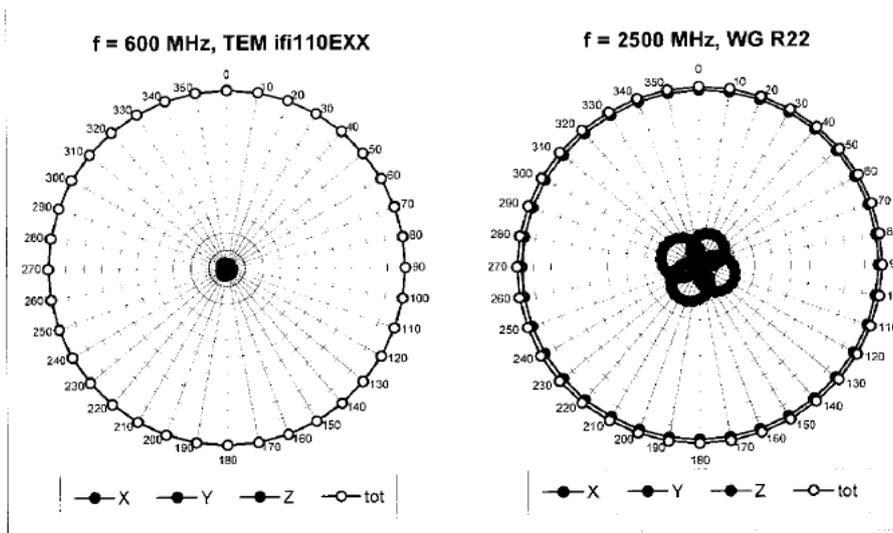


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

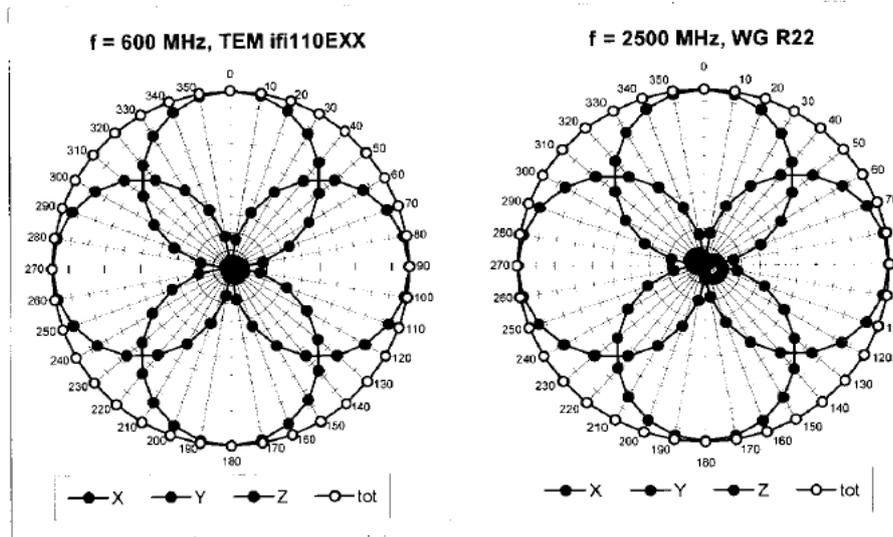
H3DV6 SN:6187

June 24, 2009

Receiving Pattern (ϕ), $\vartheta = 90^\circ$



Receiving Pattern (ϕ), $\vartheta = 0^\circ$

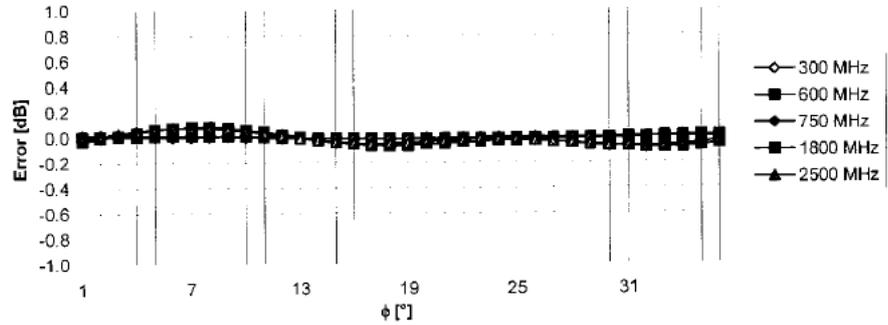




H3DV6 SN:6187

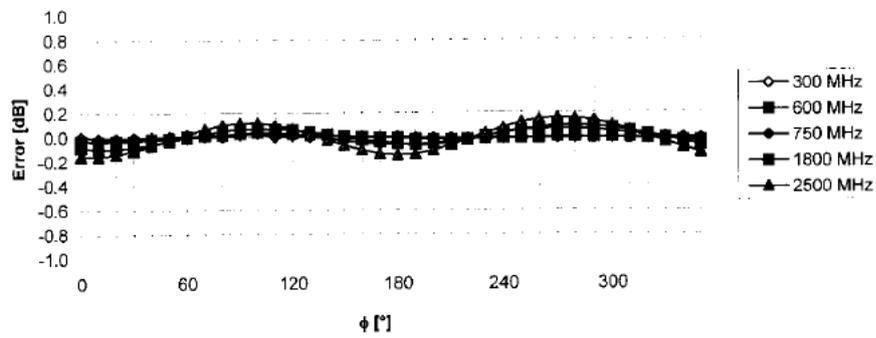
June 24, 2009

Receiving Pattern (ϕ), $\vartheta = 90^\circ$



Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$



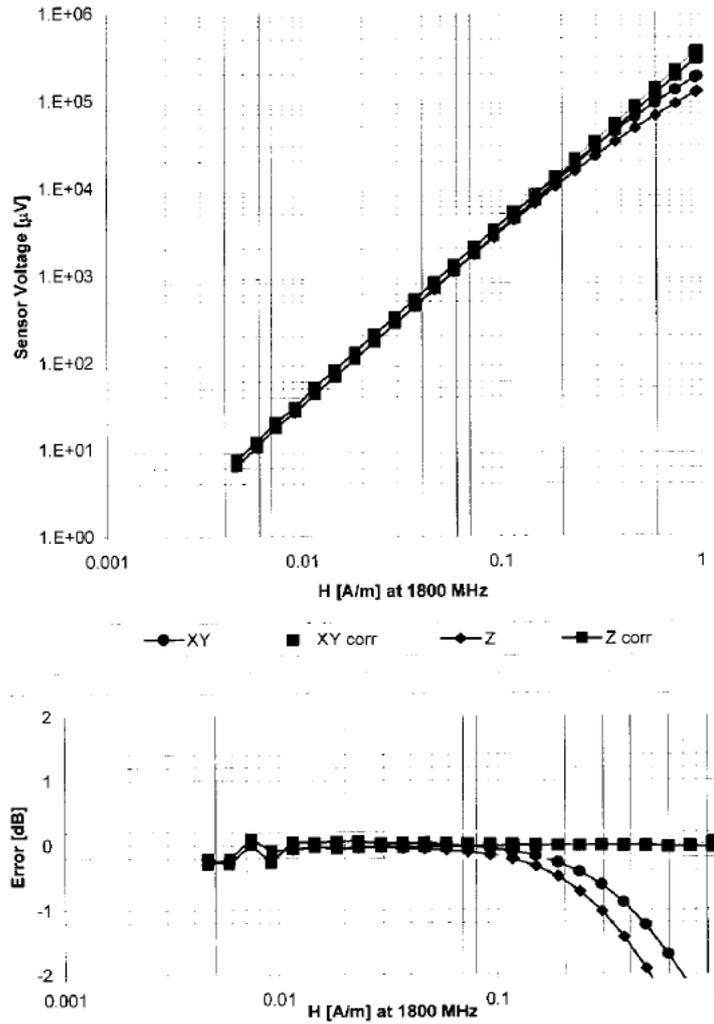
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)



H3DV6 SN:6187

June 24, 2009

Dynamic Range f(H-field) (Waveguide R22, f = 1800 MHz)



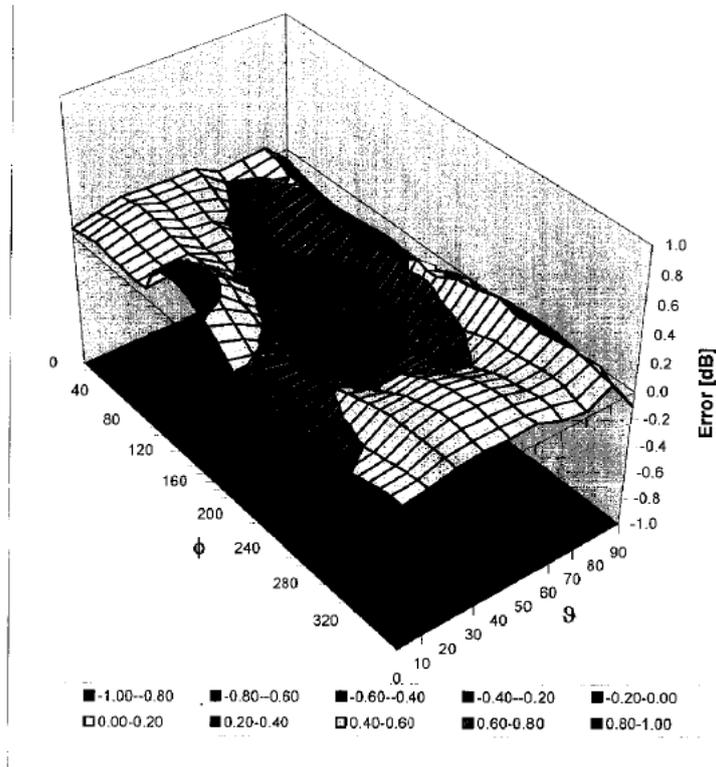
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)



H3DV6 SN:6187

June 24, 2009

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



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)



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Accreditation No.: SCS 108

Client Sporton (Auden)

Certificate No: CD835V3-1045_Sep09

CALIBRATION CERTIFICATE

Object: CD835V3 - SN: 1045
Calibration procedure(s): QA CAL-20.v4 Calibration procedure for dipoles in air
Calibration date: September 17, 2009
Condition of the calibrated item: In Tolerance

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

Calibration Equipment used (M&TE critical for calibration)

Table with 4 columns: Primary Standards, ID #, Cal Date (Certificate No.), Scheduled Calibration. Includes items like Power meter EPM-442A, Power sensor HP 8481A, Probe ER3DV6, etc.

Calibrated by: Claudio Leubler, Laboratory Technician
Approved by: Katja Pokovic, Technical Manager

Issued: September 17, 2009

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Accreditation No.: **SCS 108**

References

- [1] ANSI-C63.19-2006
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.
- [2] ANSI-C63.19-2007
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 the standards [1, 2], 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 eliminated 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, 2], 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	DASY5	V5.0 B127
DASY PP Version	SEMCAD X	V13.4 B125
Phantom	HAC Test Arch	SD HAC P01 BA, #1070
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 180 mm
Frequency	835 MHz ± 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	interpolated maximum
Maximum measured	100 mW forward power	0.457 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	170.6 V/m
Maximum measured above low end	100 mW forward power	169.8 V/m
Averaged maximum above arm	100 mW forward power	170.2 V/m

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

3 Appendix

3.1 Antenna Parameters

Frequency	Return Loss	Impedance
800 MHz	15.7 dB	(44.9 – j14.9) Ohm
835 MHz	40.5 dB	(49.2 - j0.5) Ohm
900 MHz	17.4 dB	(53.0 – j13.7) Ohm
950 MHz	20.2 dB	(47.5 + j9.2) Ohm
960 MHz	14.8 dB	(53.9 + j18.8) 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.

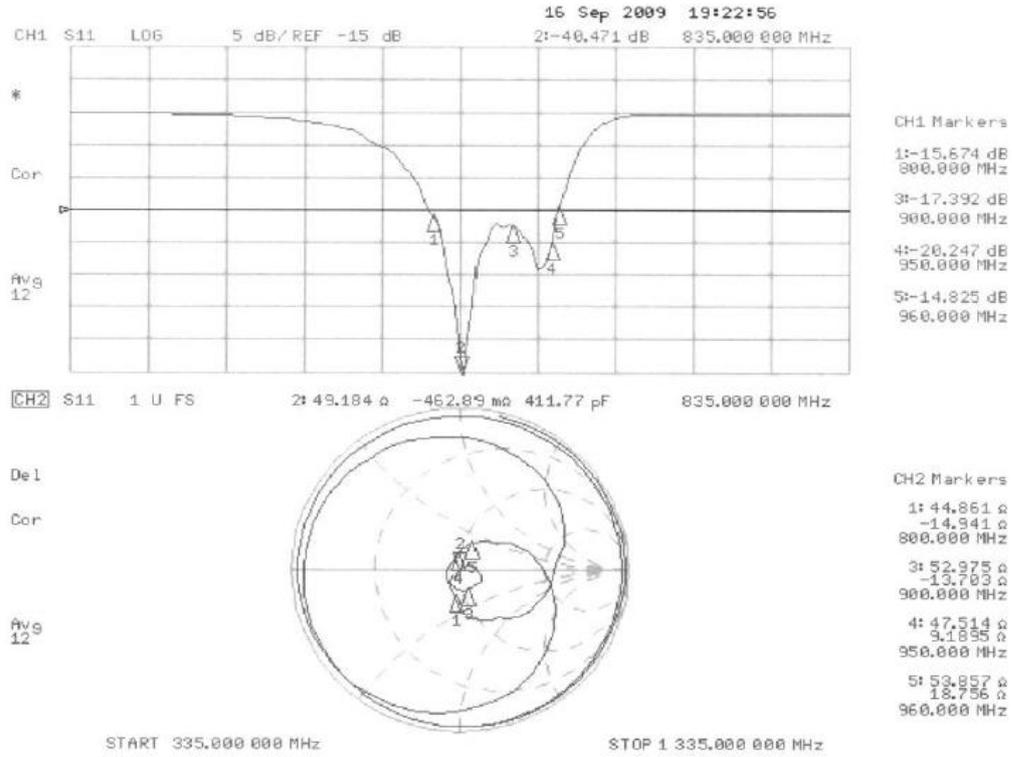
Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

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



3.3.2 DASYS4 H-field Result

Date/Time: 16.09.2009 10:26:07

Test Laboratory: SPEAG Lab2

H_CD835_1045_090916.da5

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

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Phantom section: RF Section

Measurement Standard: DASYS5 (IEEE/IEC)

DASYS5 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 22.12.2008
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.02.2009
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASYS5, V5.0 Build 127; SEMCAD X Version 13.4 Build 125

H Scan - measurement distance from the probe sensor center to CD835 Dipole = 10mm/Hearing Aid Compatibility Test (41x361x1):

Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.457 A/m

Probe Modulation Factor = 1

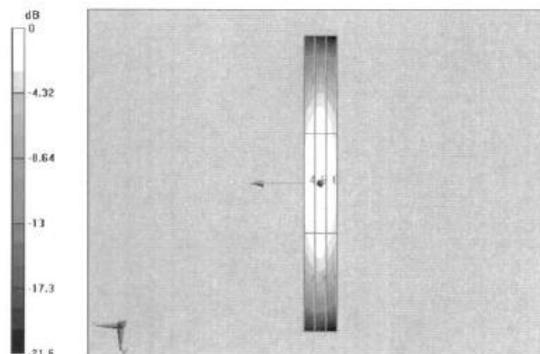
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 0.487 A/m; Power Drift = 0.00195 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 0.384 M4	Grid 2 0.410 M4	Grid 3 0.385 M4
Grid 4 0.431 M4	Grid 5 0.457 M4	Grid 6 0.429 M4
Grid 7 0.383 M4	Grid 8 0.401 M4	Grid 9 0.369 M4



0 dB = 0.457A/m

3.3.3 DASY4 E-field Result

Date/Time: 17.09.2009 09:59:19

Test Laboratory: SPEAG Lab2

E_CD835_1045_090917.da5

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

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: RF Section

Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 22.12.2008
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.02.2009
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY5, V5.0 Build 127; SEMCAD X Version 13.4 Build 125

E Scan - measurement distance from the probe sensor center to CD835 Dipole = 10mm/Hearing Aid Compatibility Test (41x361x1):

Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 170.6 V/m

Probe Modulation Factor = 1

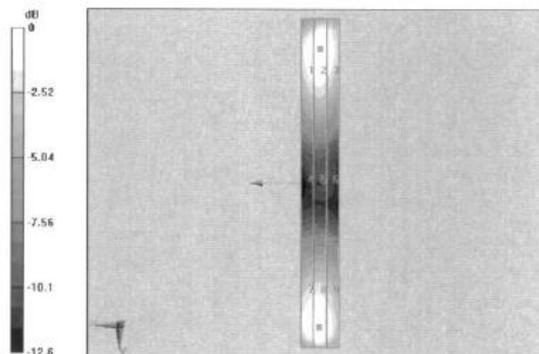
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 109.7 V/m; Power Drift = -0.035 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 164.9 M4	Grid 2 170.6 M4	Grid 3 164.4 M4
Grid 4 87.7 M4	Grid 5 89.9 M4	Grid 6 86.1 M4
Grid 7 165.1 M4	Grid 8 169.8 M4	Grid 9 159.4 M4



0 dB = 170.6V/m



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



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

Accreditation No.: **SCS 108**

Client **Sporton (Auden)**

Certificate No: **CD1880V3-1038_Sep09**

CALIBRATION CERTIFICATE

Object **CD1880V3 - SN: 1038**

Calibration procedure(s) **QA CAL-20.v4
Calibration procedure for dipoles in air**

Calibration date: **September 17, 2009**

Condition of the calibrated item **In Tolerance**

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	08-Oct-08 (No. 217-00898)	Oct-09
Power sensor HP 8481A	US37292783	08-Oct-08 (No. 217-00898)	Oct-09
Probe ER3DV6	SN: 2336	22-Dec-08 (No. ER3-2336_Dec08)	Dec-09
Probe H3DV6	SN: 6065	22-Dec-08 (No. H3-6065_-Dec08)	Dec-09
DAE4	SN 781	20-Feb-09 (No. DAE4-781_Feb09)	Feb-10

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter R&S NRP	SN: 101748	23-Sep-08 (in house check Dec-08)	In house check: Dec-10
Power sensor R&S NRP-Z91	SN: 100711	25-Aug-08 (in house check Dec-08)	In house check: Dec-10
Power sensor R&S NRP-Z91	SN: 100712	25-Aug-08 (in house check Dec-08)	In house check: Dec-10
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-08)	In house check: Oct-09
RF generator E4433B	MY 41310391	22-Nov-04 (in house check Oct-07)	In house check: Oct-09

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 17, 2009

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

Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland



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S Swiss Calibration Service

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

Accreditation No.: **SCS 108**

References

- [1] ANSI-C63.19-2006
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.
- [2] ANSI-C63.19-2007
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 the standards [1, 2], 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 eliminated 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, 2], 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	DASY5	V5.0 B127
DASY PP Version	SEMCAD X	V13.4 B125
Phantom	HAC Test Arch	SD HAC P01 BA, #1070
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 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	0.466 A/m

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

E-field 10 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW forward power	138.2 V/m
Maximum measured above low end	100 mW forward power	135.3 V/m
Averaged maximum above arm	100 mW forward power	136.8 V/m

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

3. Appendix

3.1 Antenna Parameters

Frequency	Return Loss	Impedance
1710 MHz	18.6 dB	(48.6 + j11.6) Ohm
1880 MHz	21.3 dB	(52.9 + j8.4) Ohm
1900 MHz	22.1 dB	(55.5 + j6.3) Ohm
1950 MHz	28.1 dB	(52.8 - j2.9) Ohm
2000 MHz	18.7 dB	(39.6 - j1.0) 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.

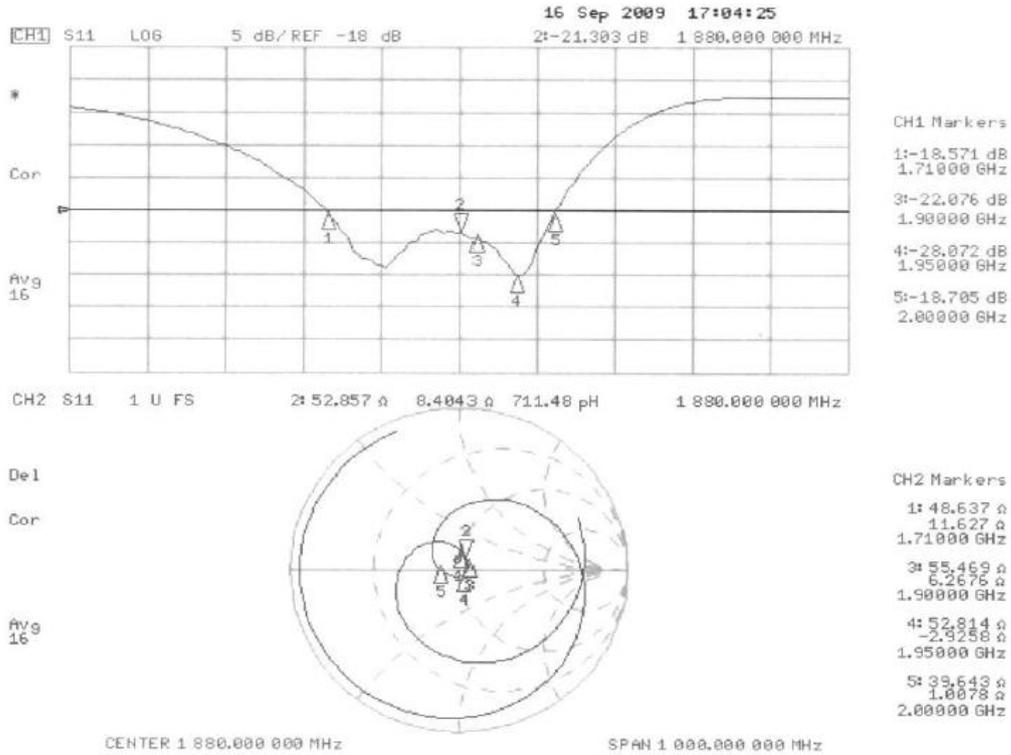
Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

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



3.3.2 DASY4 H-Field Result

Date/Time: 16.09.2009 14:27:59

Test Laboratory: SPEAG Lab2

H_CD1880_1038_090916.da5

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

Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Phantom section: RF Section

Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 22.12.2008
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.02.2009
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY5, V5.0 Build 127; SEMCAD X Version 13.4 Build 125

H Scan - measurement distance from the probe sensor center to CD1880 Dipole = 10mm/Hearing Aid Compatibility Test (41x181x1):

Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.466 A/m

Probe Modulation Factor = 1

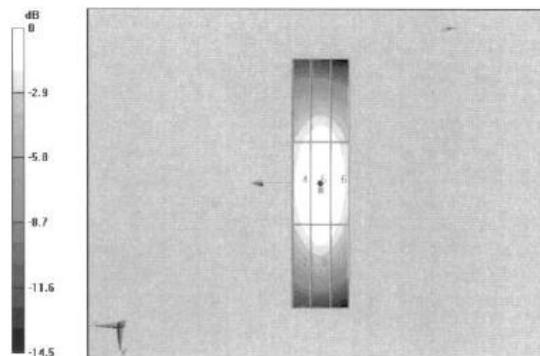
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 0.493 A/m; Power Drift = -0.010 dB

Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 0.397 M2	Grid 2 0.420 M2	Grid 3 0.403 M2
Grid 4 0.442 M2	Grid 5 0.466 M2	Grid 6 0.445 M2
Grid 7 0.407 M2	Grid 8 0.432 M2	Grid 9 0.410 M2



0 dB = 0.466A/m

3.3.3 DASY4 E-Field Result

Date/Time: 17.09.2009 15:13:12

Test Laboratory: SPEAG Lab2

E_CD1880_1038_090917.da5

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

Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: RF Section

Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 22.12.2008
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.02.2009
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY5, V5.0 Build 127; SEMCAD X Version 13.4 Build 125

E Scan - measurement distance from the probe sensor center to CD1880 Dipole = 10mm/Hearing Aid Compatibility Test (41x181x1):

Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 138.2 V/m

Probe Modulation Factor = 1

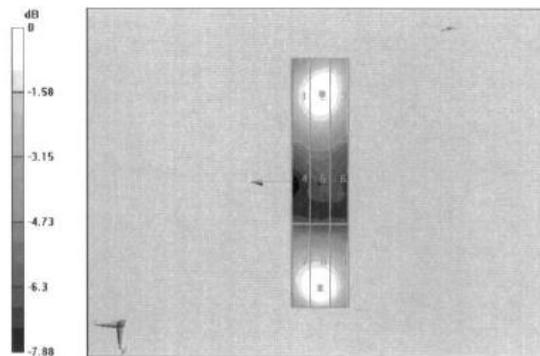
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 155.9 V/m; Power Drift = -0.00724 dB

Hearing Aid Near-Field Category: M2 (AWF 0 dB)

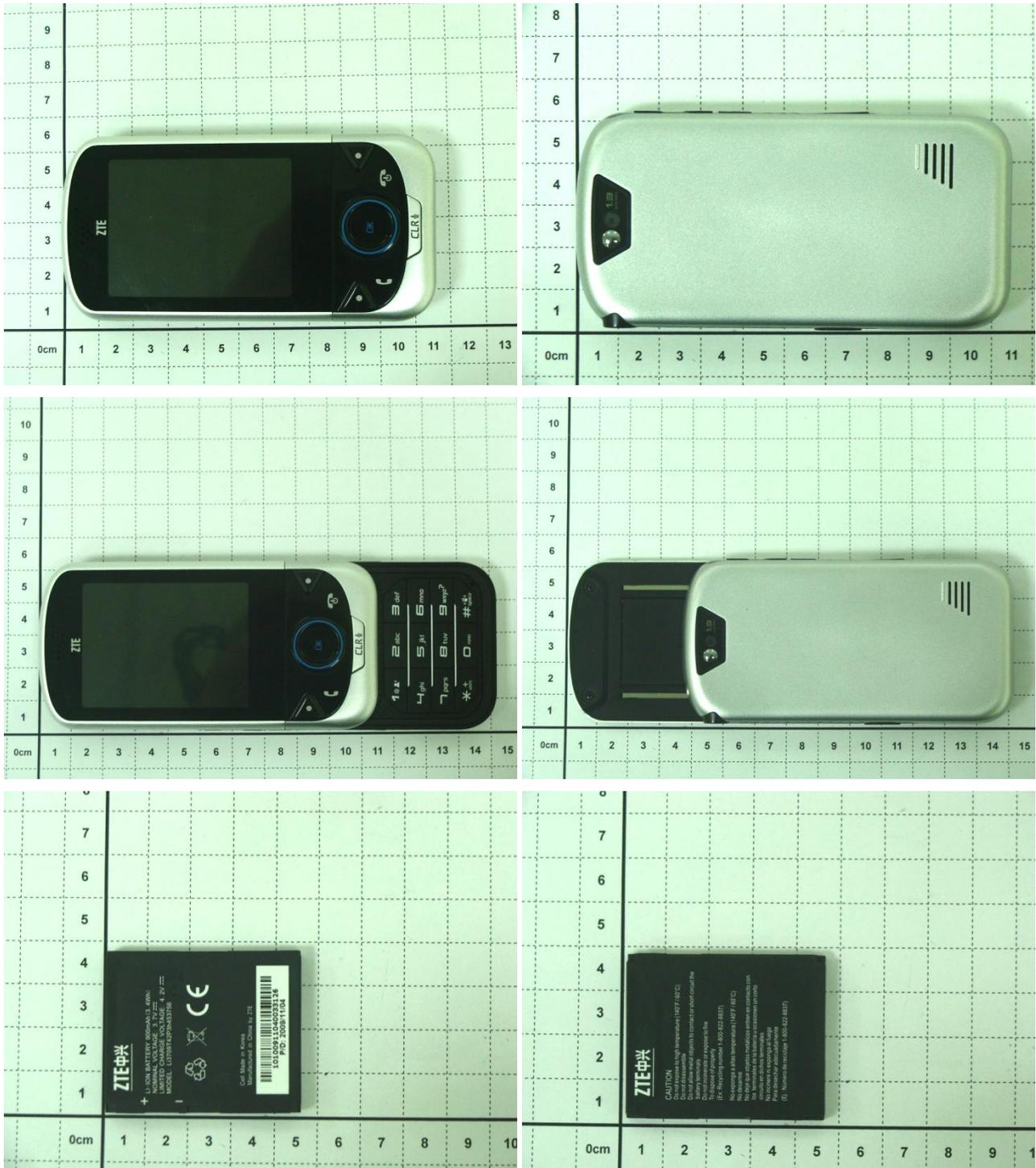
Peak E-field in V/m

Grid 1 130.2 M2	Grid 2 135.3 M2	Grid 3 132.4 M2
Grid 4 89 M3	Grid 5 91.6 M3	Grid 6 88.1 M3
Grid 7 132.8 M2	Grid 8 138.2 M2	Grid 9 132.4 M2



0 dB = 138.2V/m

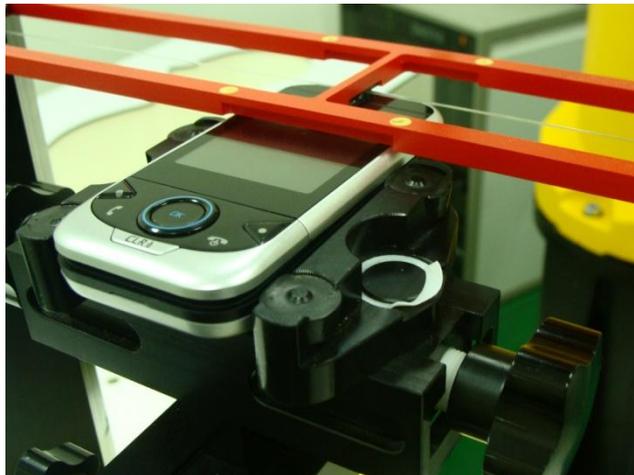
Appendix D. Product Photos



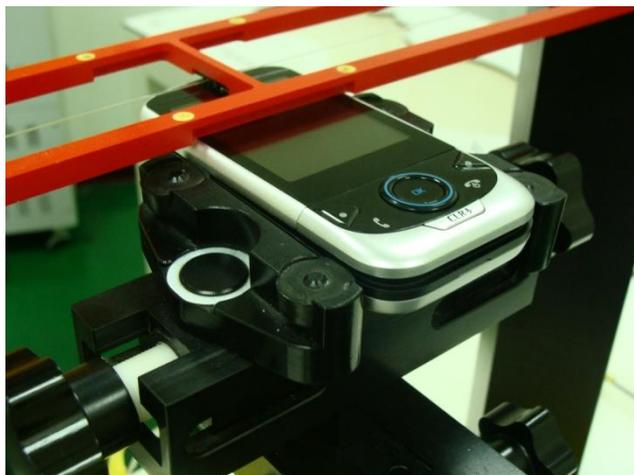
Appendix E. Test Setup Photos



Front View_Slide Off



Left Side View_Slide Off



Right Side View_Slide Off



Front View_Slide Up



Left Side View_Slide Up



Right Side View_Slide Up



Appendix F. CDMA2000 1xRTT Test Modes for HAC

The phone was tested in all normal configurations for the ear usage. These test configurations are tested at the high, middle and low frequency channels of each applicable operating mode, if applicable; each configuration is tested with the antenna in its fully stowed and deployed positions. The signal was setup by linking an over the air connection between the DUT and an Agilent 8960 (E5515C Wireless Communications Tester). The CDMA radio is available on IS-95 (Radio Configuration 1) and CDMA2000 1xRTT (Radio Configuration 3). The DUT supports IS-95 2G networks, CDMA2000 1xRTT for Cellular band and PCS band. The maximum peak field is chosen for HAC testing for worst case scenario. A full HAC measurement in this report is done in eighth rate of RC1+SO3 mode for Cellular and PCS band.

Peak Field List:

Band	RC	SO	Type	Data Rate	Peak Field (V/m)
Cellular	1	2	Loop	Full	75.7
				Eighth	79
	1	3	Voice	-	82
	1	55	Loop	Full	78.3
				Eighth	80.8
	2	17	Voice	-	80.9
	2	32768	Voice	-	80.5
	3	2	Loop	Full	55
				Eighth	35
	3	3	Voice	-	34.9
	3	55	Loop	Full	55.8
				Eighth	34.3
	4	3	Voice	-	34.8
	5	17	Voice	-	35.4
5	32768	Voice	-	35.3	



Conducted Power List:

Band	RC	SO	Type	Data Rate	Low Ch (1013)	Mid Ch (384)	High Ch (777)
Cellular	1	2	Loop	Full	23.64	23.51	23.65
				Eighth	23.61	23.56	23.56
	1	3	Voice	-	23.62	23.58	23.62
	1	55	Loop	Full	23.57	23.57	23.67
				Eighth	23.52	23.51	23.63
	2	17	Voice	-	23.56	23.57	23.69
	2	32768	Voice	-	23.52	23.61	23.62
	3	2	Loop	Full	23.58	23.45	23.56
				Eighth	23.68	23.57	23.54
	3	3	Voice	-	23.61	23.53	23.49
	3	55	Loop	Full	23.63	23.61	23.72
				Eighth	23.57	23.58	23.63
4	3	Voice	-	23.68	23.58	23.64	
5	17	Voice	-	23.66	23.56	23.59	
5	32768	Voice	-	23.7	23.52	23.68	

Band	RC	SO	Type	Data Rate	Low Ch (25)	Mid Ch (600)	High Ch (1175)
PCS	1	2	Loop	Full	23.3	23.52	23.66
				Eighth	23.33	23.58	23.66
	1	3	Voice	-	23.52	23.64	23.75
	1	55	Loop	Full	23.48	23.53	23.93
				Eighth	23.47	23.56	23.96
	2	17	Voice	-	23.53	23.62	23.85
	2	32768	Voice	-	23.47	23.61	23.9
	3	2	Loop	Full	23.33	23.57	23.88
				Eighth	23.51	23.64	23.86
	3	3	Voice	-	23.39	23.69	23.92
	3	55	Loop	Full	23.41	23.59	23.76
				Eighth	23.45	23.61	23.78
4	3	Voice	-	23.31	23.57	23.7	
5	17	Voice	-	23.36	23.59	23.69	
5	32768	Voice	-	23.35	23.6	23.71	

*Unit: dBm



Reference:

- [1] SAR Measurement Procedures for 3G Devices CDMA 2000/Ev-Do/WCDMA/HSDPA, June 2006
Laboratory Division Office of Engineering and Technology Federal Communications Commission
- [2] 3.1.2.3.4 Maximum RF Output Power 3GPP2 C.S0033-0 Version 2.0, Date: 12 December 2003
Recommended Minimum Performance Standards for cdma2000 High Rate Packet Data Access
Terminal
- [3] Preliminary Guidance for Reviewing Applications for Certification of 3G Devices, May 9, 2006.
- [4] Publication Number: 766989 Rule Parts: 90S Publication Date: 04/09/2007