FCC HAC Test Report

Test Report Number: WR-993.001

Terminal device: Type: Nokia RM-155, HW: 3001, SW: v PR100_05w21_46.nbp (Detailed information is listed in section 5).

Originator:	Anu Balijepalli
Function:	TCC – Dallas
Version/Status:	2.0 Approved
Location:	TCC Directories
Date:	07 July 2006

Change History:

Version	*Date*	*Status*	*Handled By*	*Comments*
0.1	29 June 2006	Draft	Anu Balijepalli	Initial Draft
0.2	29 June 2006	Review	Anu Balijepalli	Submit for Approval
1.0	29 June 2006	Approval	Nerina Walton	Approved
1.1	07 July 2006	Update	Anu Balijepalli	
2.0	07 July 2006	Approved	Nerina Walton	Approved

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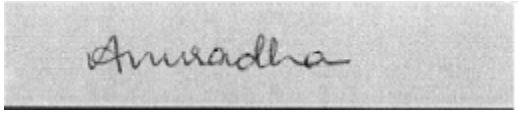
Date and signatures:

07 July 2006

For the Contents:



Anu Balijepalli,
Technical Review

Nerina Walton,
Manager Review

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1. GENERAL

1.1 Objective

This test is performed to ensure that the EUT meets the requirements required by the FCC Method of Measurement for near field E and H emissions. Please note that this report is only for near field emissions, not for the T-coil HAC testing.

1.2 Test Summary

Test Results: *The test result relates only to those tested devices mentioned in Section 5 of this test report.*

Sample #	Test Performed	Reference	Category
1	Near Field Emissions- E field Near Field Emissions- H field	ANSI C63.19	M3

2. LIST OF ABBREVIATIONS, ACRONYMS AND TERMS

2.1 Abbreviations

dB - decibel
dBm - decibels per milliwatt (absolute measurement)
MHz - megahertz or 1000000 Hertz
V/m – Volts per meter
A/m – Amps per meter

2.2 Acronyms

AMPS - Advanced Mobile Phone System
BSS - Base Station Simulator
CDMA - Code Division Multiple Access
ESN - Electronic Serial Number
EUT - Equipment under Test
GSM - Global System for Mobile communications
IMEI - International Mobile Equipment Identity
PCS - Personal Communication System
RF- Radio Frequency
TDMA - Time Division Multiple Access

2.3 Terms

Base Station Simulator (BSS) - simulates all the necessary signals that a phone would experience while on a live network. There are many types of base station simulators catering for all current protocols, i.e., GSM, AMPS, TDMA, and CDMA.

Cellular - refers to a frequency in the 800MHz band.

PCS - refers to a frequency in the 1900MHz band.

Crest Factor - is the relation between the peak power and the average power in a signal.

3. STANDARDS BASIS

Testing has been carried out in accordance with:

REF.	Code of the standard	Name of the standard
1	-	ANSI C63.19

Note: Unless otherwise stated, (by reference to a version number and a publication date), the latest version of the above documents applies.

Deviations:

Not Applicable.

4. TEST EQUIPMENT LIST

The listing below indicates the test equipment utilized for the test (s). Calibration interval on all items listed can be obtained from the Engineering Services Group within NMP, Product Creation - Dallas. Where relevant, measuring equipment is subjected to in-service checks between testing. TCC - Dallas shall notify clients promptly, in writing, of identification of defective measuring equipment that casts doubt on the validity of results given in this report.

Test Equipment	NMP #	Calibration Interval	Calibration Expiry
SPEAG DASY4 Robot System	2056	NA	NA
SPEAG Data Acquisition Electronics (DAE)	2292	12 months	Jan - 2007
SPEAG E-field Probe ER3DV6	2955	12 months	Jan- 2007
SPEAG H-field Probe H3DV6	2957	12 months	Jan- 2007
SPEAG 1880MHz Dipole CD1880V3	4082	12 months	Nov-2006
SPEAG 835MHz Dipole CD835V3	4081	12 months	Dec-2006
Signal Generator HP8648C	0796	12 months	Aug-2006
Boonton Powermeter 4232A	2996	12 months	Sep-2006
AR Power Amplifier 5S1G4	0188	NA	NA
R&S CMU 200	4064	12 months	Feb-2007
R&S FSP	3462	12 months	Jul-2006

5. EQUIPMENT-UNDER-TEST (EUT)

The results in this report relate only to the items listed below:

5.1 Description of Tested Device(s):

Sample #	Mode of Operation	Date of Receipt	Condition of Sample	Item	Identifying Information
1	CDMA 800/1900	6/21/06	Good	Phone	Type: RM-155 Model: 2365i ESN: 026/01186372 HW: 3001 SW: v pr100_05w21_46nbp

5.2 Photograph of Tested Device(s):

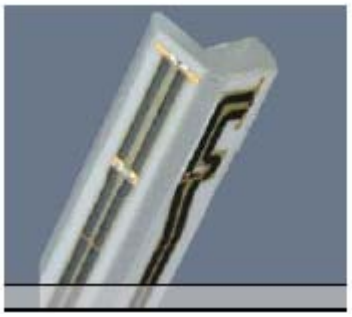
Please refer to WR993.002_V1_HAC_NF_Test_Set-up_Photos.

6. TEST METHOD(S) AND SETUP(S)

Testing was performed in accordance with ANSI C63.19.

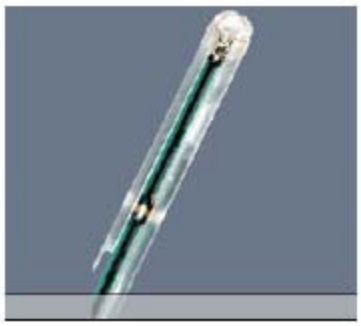
6.1 Probe Description

E field Probe Description



Construction
One dipole parallel, two dipoles normal to probe axis
Built-in shielding against static charges
Calibration
In air from 100 MHz to 3.0 GHz (absolute accuracy ±6.0%, k=2)
Frequency
100 MHz to > 6 GHz; Linearity: ± 0.2 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; 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
Application
General near-field measurements up to 6 GHz
Field component measurements
Fast automatic scanning in phantoms

H field Probe Description



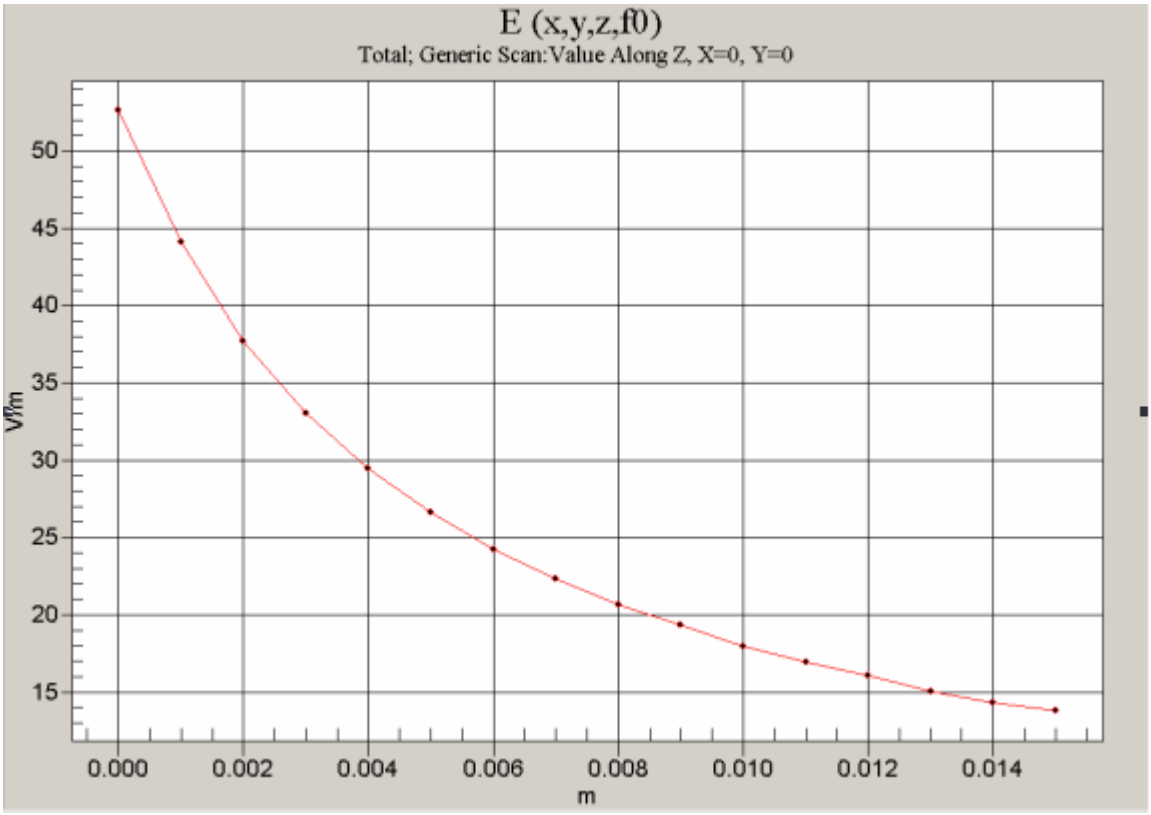
Construction
Three concentric loop sensors with 3.8 mm loop diameters
Resistively loaded detector diodes for linear response
Built-in shielding against static charges
Frequency
200 MHz to 3 GHz (absolute accuracy ± 6.0%, k=2); Output linearized
Directivity
± 0.25 dB (spherical isotropy error)
Dynamic Range
10 mA/m to 2 A/m at 1 GHz
E-Field Interference
< 10% at 3 GHz (for plane wave)
Dimensions
Overall length: 330 mm (Tip: 40 mm)
Tip diameter: 6 mm (Body: 12 mm)
Distance from probe tip to dipole centers: 3 mm
Application
General magnetic near-field measurements up to 3 GHz
Field component measurements
Surface current measurements

Measurements in air or liquids
Low interaction with the measured field

Probe Tip Description

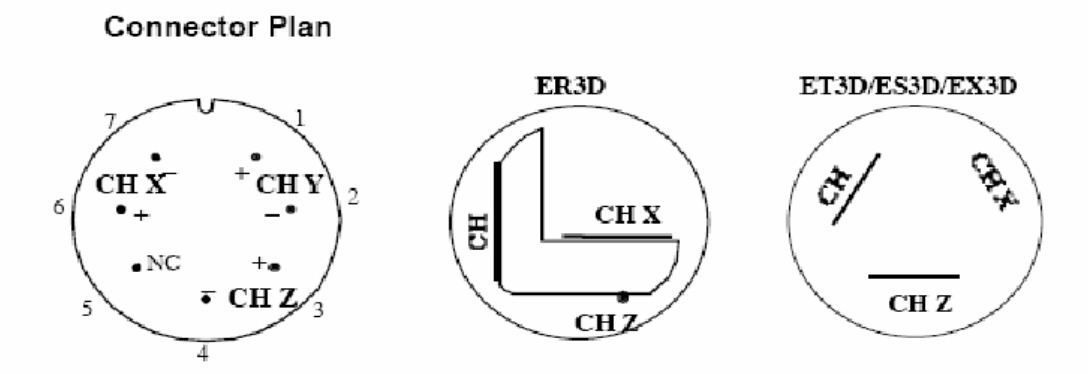
HAC field measurements take place in the close near field with high gradients. Increasing the measuring distance from the source will generally decrease the measured field values. Magnetic field sensors are measuring the integral of the H-field across their sensor area surrounded by the loop. They are calibrated in precise, homogenous 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 center value. But it will be different from 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 behaviour 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.



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

The electric field probes have a more irregular intenal 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. Their geometric center is at 2.5mm from the tip, and the element ends are 1.1mm closer to the tip.



The antistatic shielding inside the probe is connected to the probe connector case. It is recommended to connect the probes with the amplifier using a short and well-shielded cable and to connect the cable shielding with the connector case.

Instrumentation Chain:

Conversion of Connector Voltage to E field

$$E_i = \sqrt{\frac{u_i + \left(u_i^2 .CF\right)/\left(DCP\right)}{Norm_i .ConvF}}$$

whereby

E_i = Electric field in V/m

u_i = Voltage of channel i at the connector in μV

$Norm_i$ = Sensitivity of channel in $\mu V/\left(V/m\right)^2$

ConvF = enhancement factor in liquid (ConvF = 1 for Air)

DCP = Diode compression point in μV

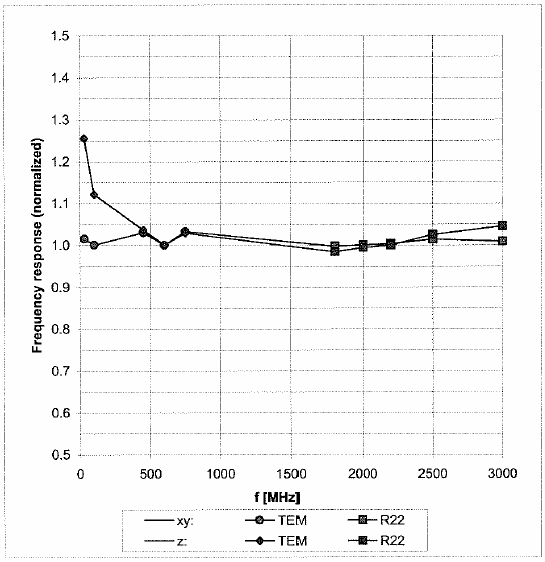
CF = Signal Crest Factor (peak power/average power)

Probe Response to Frequency

The E-field sensors have inherently a very flat frequency response. They are calibrated with a number of frequencies resulting in a common calibration factor, with the frequency behaviour documented in the calibration certificate.

Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide R22)

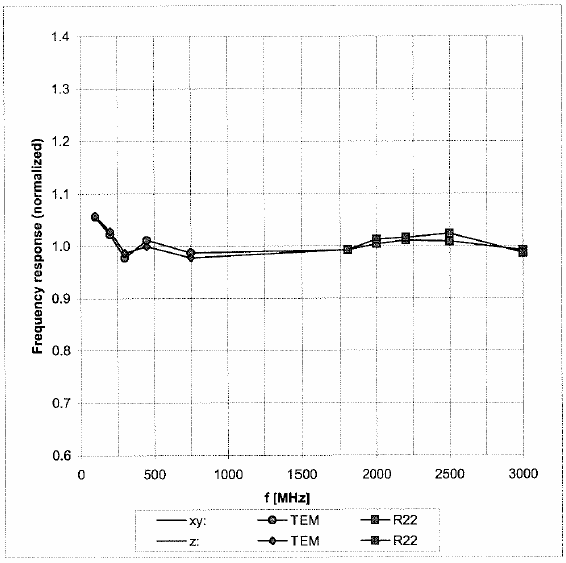


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

H-fileld sensors have frequency dependant sensitivity, which is evaluated for a series of frequencies also visible in the probe calibration certificate. The calibration factors result from a fiiting algorithm. The proper conversion is calculated by the DASY4 software depending on the frequency setting in the procedure.

Frequency Response of H-Field

(TEM-Cell:ifi110, Waveguide R22)



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

Conversion to Peak

Peak is defined as Peak Envelope Power. All raw measurements from the HAC measurement system are RMS values. The DASY4 system incorporates the crest factor of the signal in the computation of the RMS values. Although the software also has capability to estimate the peak field by applying a square root of crest factor value to the readings, the probe modulation factor was applied manually instead per PC63.19 in the measurement tables in this report. The equation to convert the raw measurements in the data tables are:

$$\text{Peak Field} = 20 \log (\text{Raw} \times \text{PMF})$$

Where:

Peak Field = Peak field (in dBV/m or dBA/m)

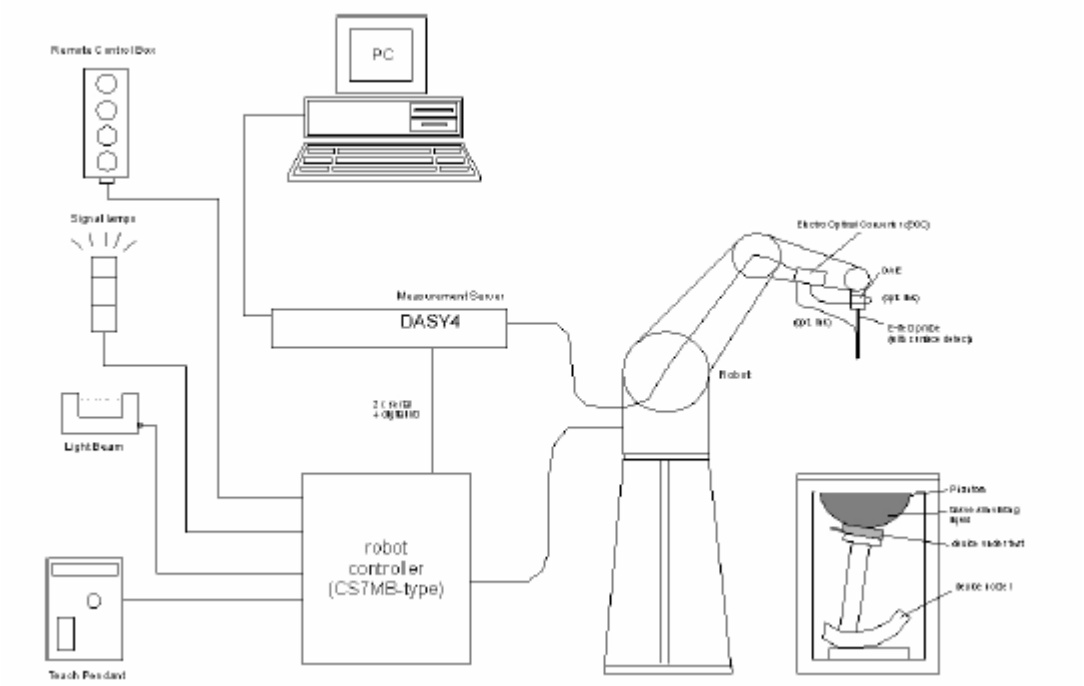
Raw = Raw field measurement from the measurement system (in V/m or A/m).

PMF = Probe Modualtion Factor (in linear units).

6.2 Speag Robotic System

E-field and H-field measurements are performed using the DASY4 automated dosimetric assessment system. The DASY4 is made by Schmid & Partner Engineering AG (SPEAG) and consists of high precision robotics system (Staubli), robot controller, Pentium 4 computer, near- field probe, probe alignment sensor, and the HAC phantom. The robot is a six- axis industrial robot performing precise movements to the position the probe to the location of maximum EMF.

System Hardware



A cell controller system contains the power supply, robot controller; teach pendant, and a remote control used to drive the robot motors. The PC consists of RF meaurement system DASY4 V4.5 with HAC extension, A/D interface card, monitor, mouse and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD conversion, offset measurements, mechanical surface detection, collision detection, etc is connected to the Electro – optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

The 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 PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe-mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built- in VME-bus computer.

Data Evaluation

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:

$$V_i = U_i + U_2 * (cf/dcpi)$$

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

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

E-field probes: $E_i = \sqrt{\frac{V_i}{Norm_i x ConvF}}$

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

with V_i = compensated signal of channel i (i = x, y, z)
$Norm_i$ = sensor sensitivity of channel i (i = x, y, z)
μV/(V/m)$_2$ for E-field Probes
ConvF = sensitivity enhancement in solution
a_{ij} = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
E_i = electric field strength of channel i in V/m
H_i = magnetic field strength of channel i in A/m

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

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The 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 <5ms. In the current implementation, DASY4 waits longer than 100 ms after having reached the grid point before starting a measurement, i.e., the response time uncertainty is negligible.

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

6.3 Test Setup

Please refer to WR993.002_V1_HAC_NF_Test_Set-up_Photos.

7. PASS/FAIL CRITERIA

The EUT must meet the following M3 category standards –

Category	Wireless Device Parameters		
Near field	AWF	E-field Emissions Peak – V/m	H-field Emissions Peak – A/m
Category M3	AWF =0 (TDMA, CDMA)	63.1 to 112.2	0.19 to 0.34
	AWF = -5 (GSM)	47.3 to 84.1	0.14 to 0.25
Category M4	AWF =0 (TDMA, CDMA)	< 63.1	< 0.19
	AWF = -5 (GSM)	< 47.3	< 0.14

8. TEST PROCEDURE

The following illustrates a typical RF emissions test scan over a wireless communication device:

- Proper operation of the field probe, probe measurement system, other instrumentation, and the positioning system was confirmed.
- WD is positioned in its intended test position, acoustic output point of the device perpendicular to the field probe.
- The WD 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.
- The center sub-grid was centered over the center of the acoustic output (also audio band magnetic output, if applicable). The WD audio outout was positioned tangent (as physically possible) to the measurement plane.
- A surface calibration was performed before each setup change to ensure repeatable spacing and proper maintenance of the measurement plane using the HAC Phantom.
- The measurement system measured the field strength at the reference location.
- Measurements at 2mm increments in the 5x5 cm region were performed and recorded. A 360 deg 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.
- The system performed a drift evaluation by measuring the field at the reference location.
- Same steps were done for both the E and H field measurements.

Please also refer to WR993.002_V1_HAC_NF_Test_Set-up_Photos.

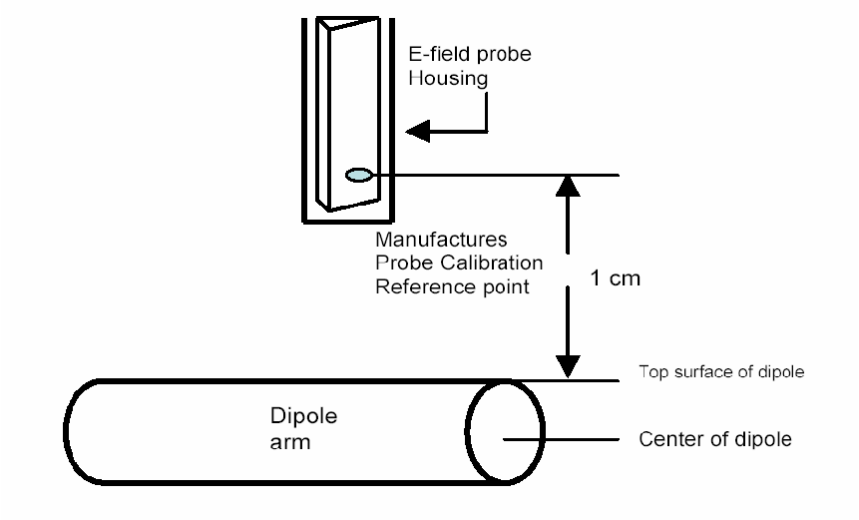
9. SYSTEM VALIDATION

The input signal was an unmodulated continous wave. The following points were taken into consideration in performing the system validation:

Average Input Power = 100mW (20dBm RMS) after adjustment for return loss.

The test fixture must meet the 2-wavelength separation criterion.

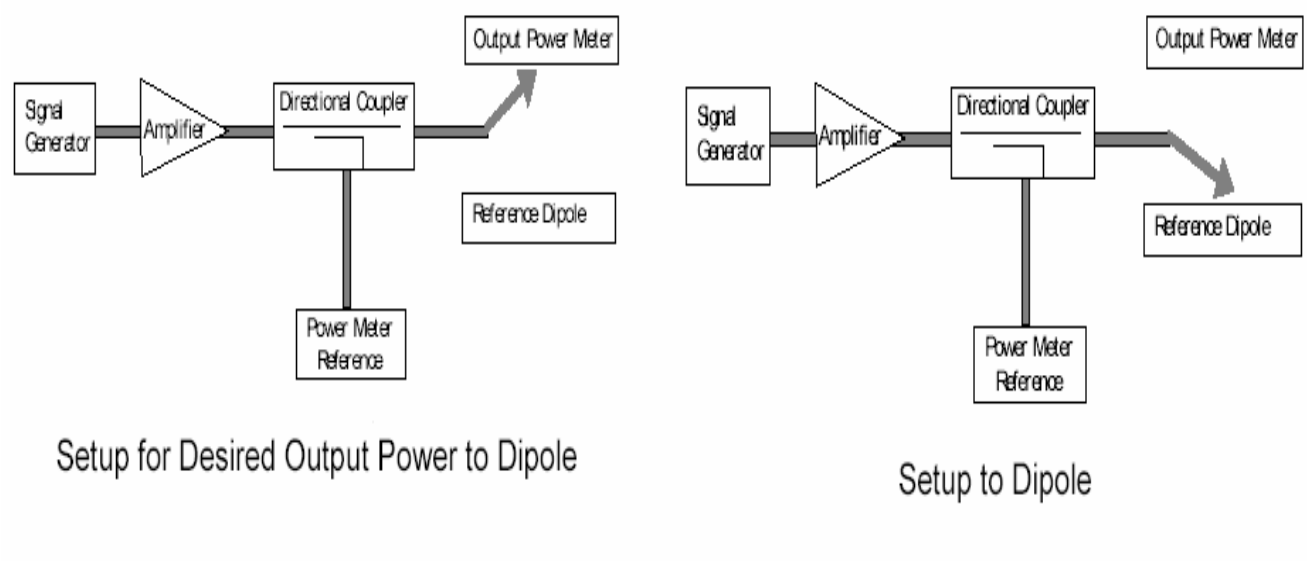
The proper measurement of the 1cm probe to dipole separation, which is measured from the top surface of the dipole to the calibration reference point of the sensor, defined by the probe manufacturer is shown in the following picture:



To assure proper operation of the near-field measurement probe the input power to the dipole shall be commensurate to with the full rated output power of the wireless device (eg. – for a cellular phone wireless device the average peak antenna input power will be on the order of 100mW (ie, 20dBm) RMS after adjustment for any mismatch.

A dipole antenna meeting the requirements in PC63.19 was placed in the position normally occupied by the WD. The length of the dipole was scanned with both E-field and H-field probes and the maximum values for each were recoreded.

Using the near-field measurement system, scan the antenna over the radiating dipole and record the greatest field reading observed. Due to the nature of E-fields about freespace dipoles, the two E-field peaks measured over the dipole are averaged to compensate for non-paralellity of the setup, See manufacturer method on dipole calibration certificates, page 2. Field strength measurements shall be made only when the probe is stationary.

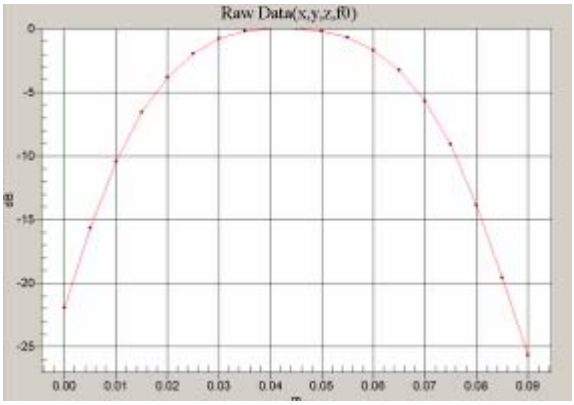


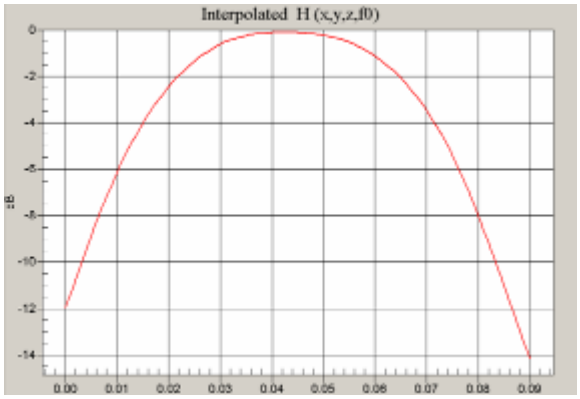
Using this setup configuration, the signal generator was adjusted for the desired output power (100mW) at a specified frequency. The reference power from the coupled port of the directional coupler is recorded. Next, the output cable is connected to the reference dipole, as shown in the figure above.

The input signal was adjusted until the reference power from the coupled port of the directional coupler was the same as previously recorded, to compensate for the impendance mismatch between the output cable and the reference dipole.

To assure proper operation of the near-field measurement probe the input power to the reference dipole was verified to the full rated output power of the wireless device. The dipole was secured in a holder in a manner to meet the 20dB reflection. The near-field measurement probe was posbtioned over the dipole.

The antenna was scanned over the appropriate sized area to cover the dipole from end to end. SPEAG uses 2D interpolation algorithms between the measured points. Please see below two-dimensional plots showing that the interpolated values interpolate smoothly between 5mm steps for a free space RF dipole:





Validations were performed for CW at 20dBm peak power.

		Recorded	Target Value	% deviation
835 MHz	E field	163.5	163.5	0.0
	H field	0.424	0.448	5.4
1880 MHz	E field	129.5	134.2	3.5
	H field	0.446	0.447	0.2

Note: Please see Appendix A for the Validation Scans

MODULATION FACTOR

A calibration was made of the modulation response of the probe and its instrumentation chain. This calibration was performed with the field probe, attached to its instrumentation. The response of the probe system to a CW field at the frequency of interest is compared to its response to a modulated signal with equal peak amplitude to that of a CW signal. The field level of the test signals are ensured to be more than 10dB 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 reading was applied to the DUT measurements.

This was done using the following procedure:

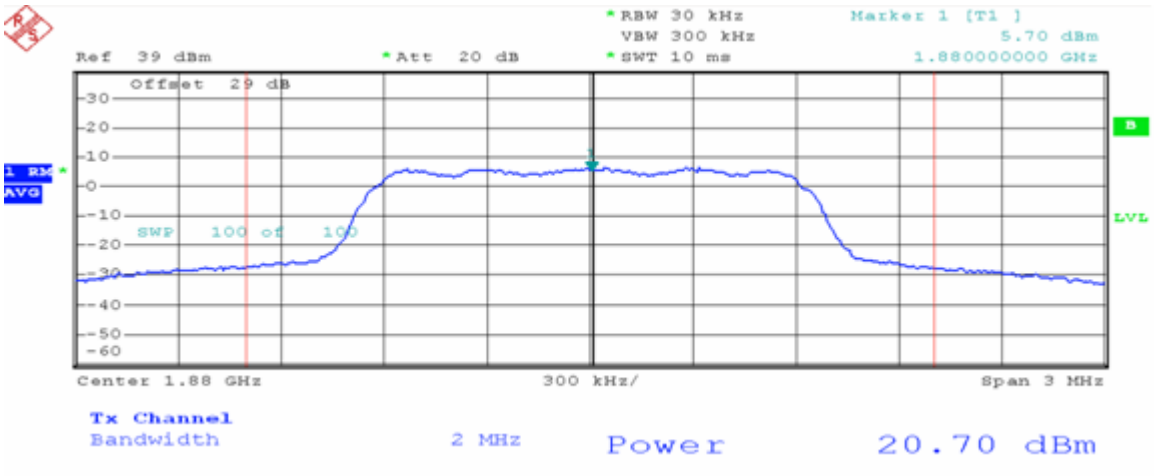
- The probe was illuminated with a CW signal at the intended measurement frequency.
- The probe was positioned at the field maxima over the dipole antenna (determined afer an area scan over the dipole).
- The reading of the probe measurement system of the CW signal at the maximum point was recorded.
- Using a Spectrum Analyzer, the modulated signal adjusted with the same peak level of the CW signal was determined.
- The probe measurement system reading was recorded with the modulated signal.
- The ratio of the CW reading to the modulated signal reading is the probe modulation factor (PMF) for the modulation and field probe combination.
- Same steps are repeated at all frequency bands and for both E and H field probes.

The modulation factors obtained were applied to readings taken of the actual wireless device, in order to obtain an accurate peak field reading using the formula:

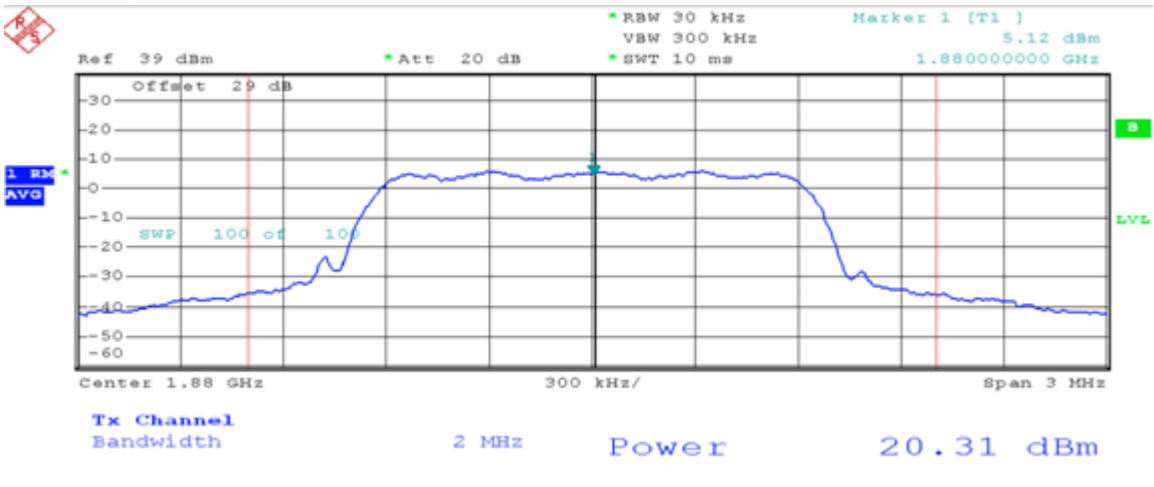
$$Peak = 20\log(Raw \times PMF)$$

This method correlates well with the modulation using the DUT in the alternative substitution method. See below for correlation of signal:

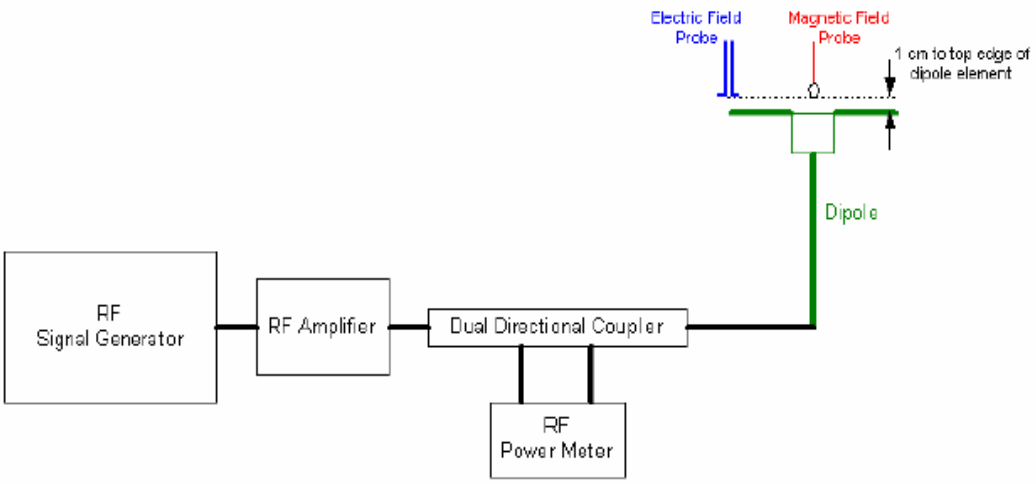
Wireless Device Modulated Signal:



Signal Generator Modulated Signal:

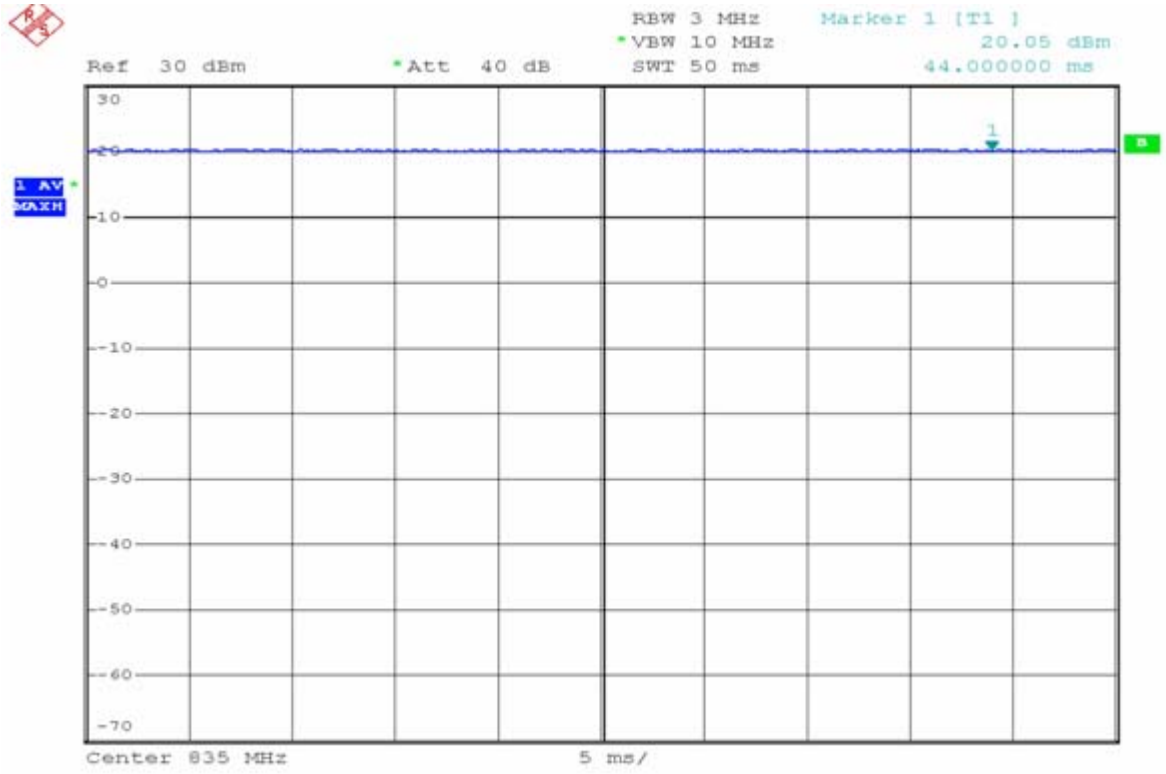


Modulation Factors were performed for CW, 80%AM and the modulated signal at 20dBm peak power, See below for the picture as well as the Spectrum Analyzer Plots.

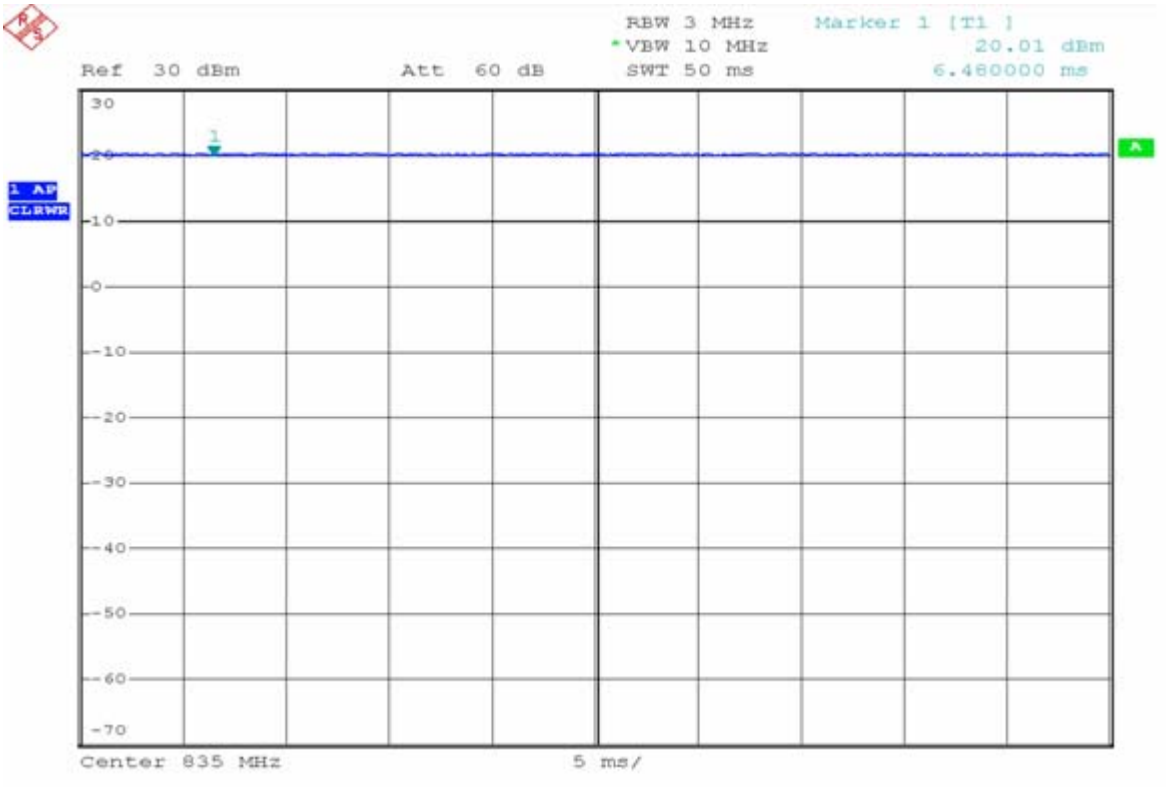


Determining Modulation Factor Probe Setup

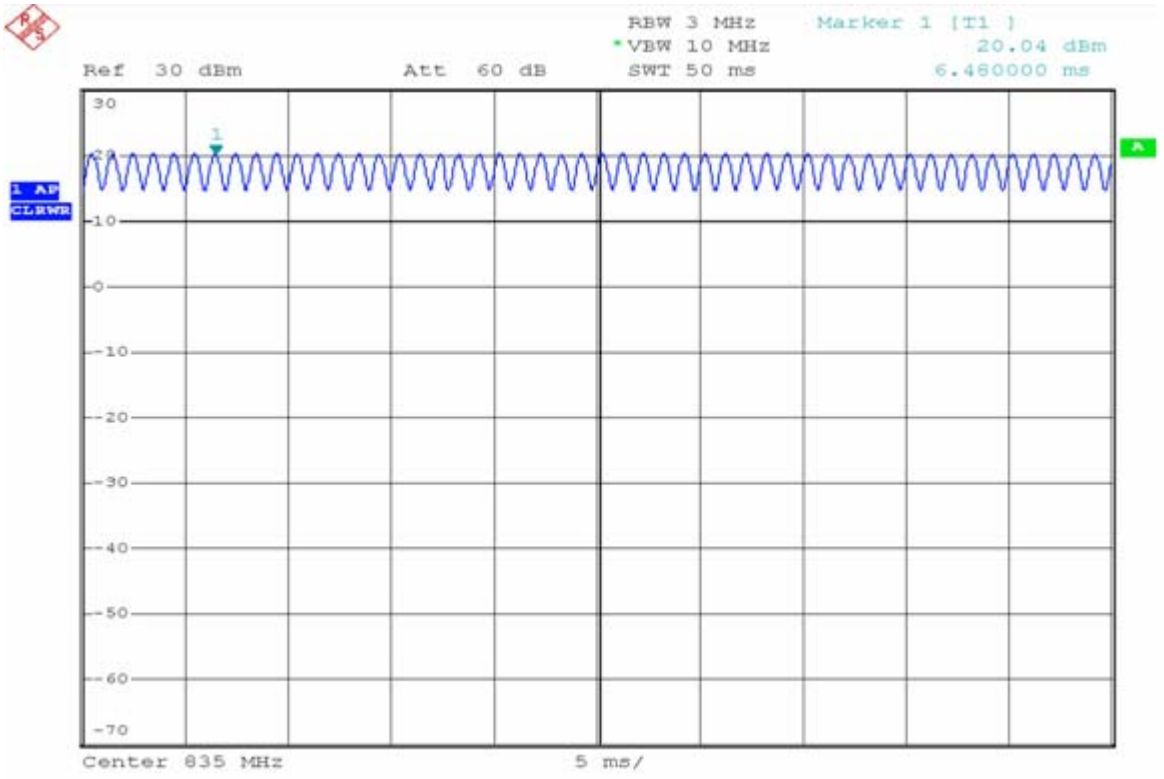
CDMA Signal for 800MHz band:



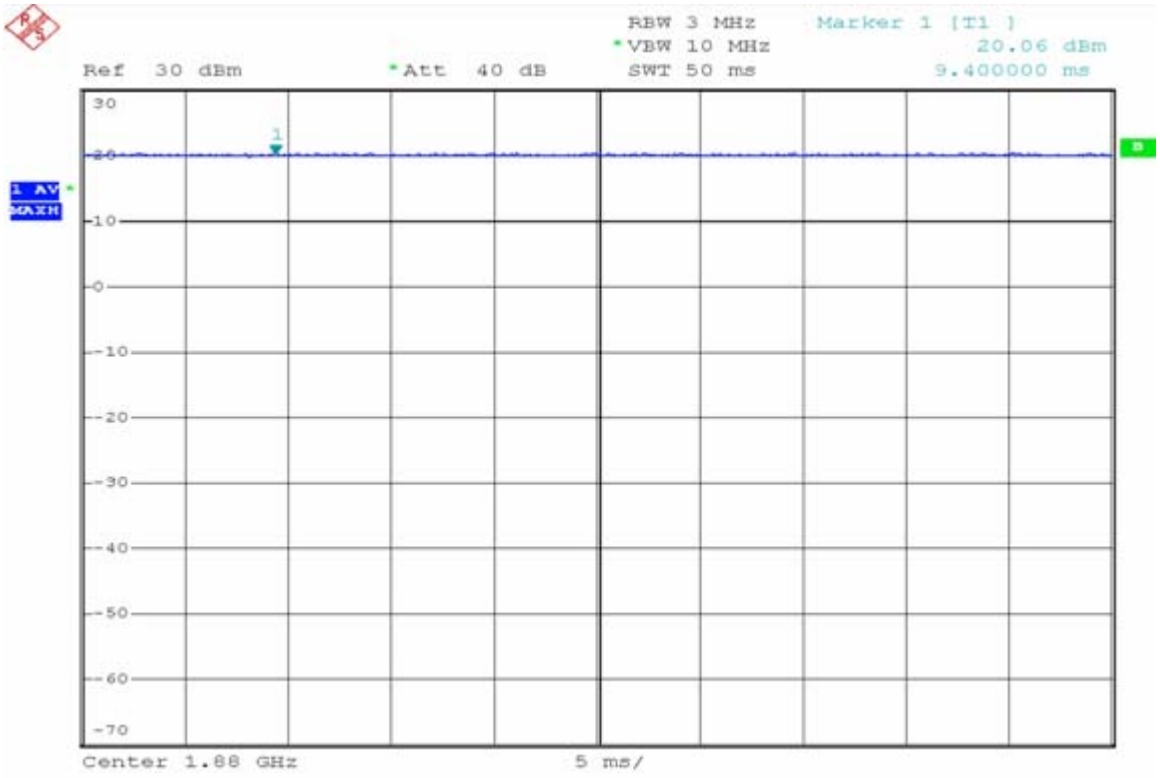
CW Signal for 800MHz band:



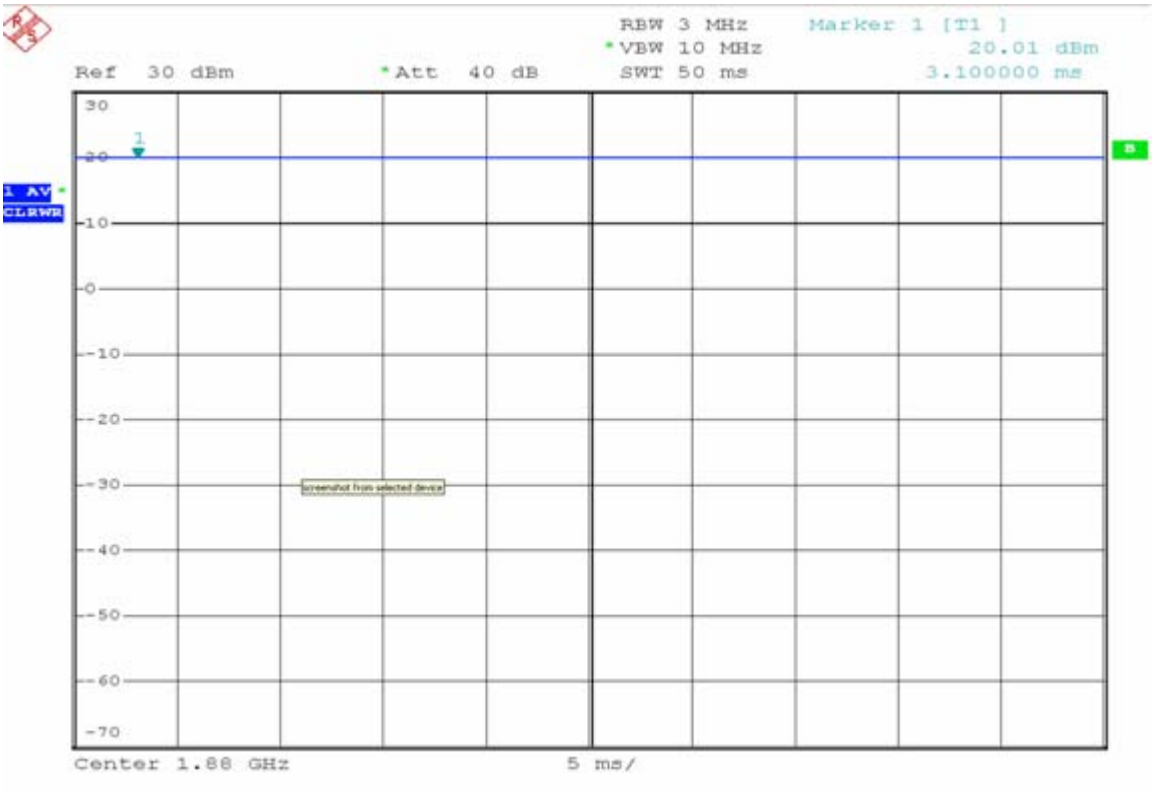
80%AM Signal for 800MHz band:



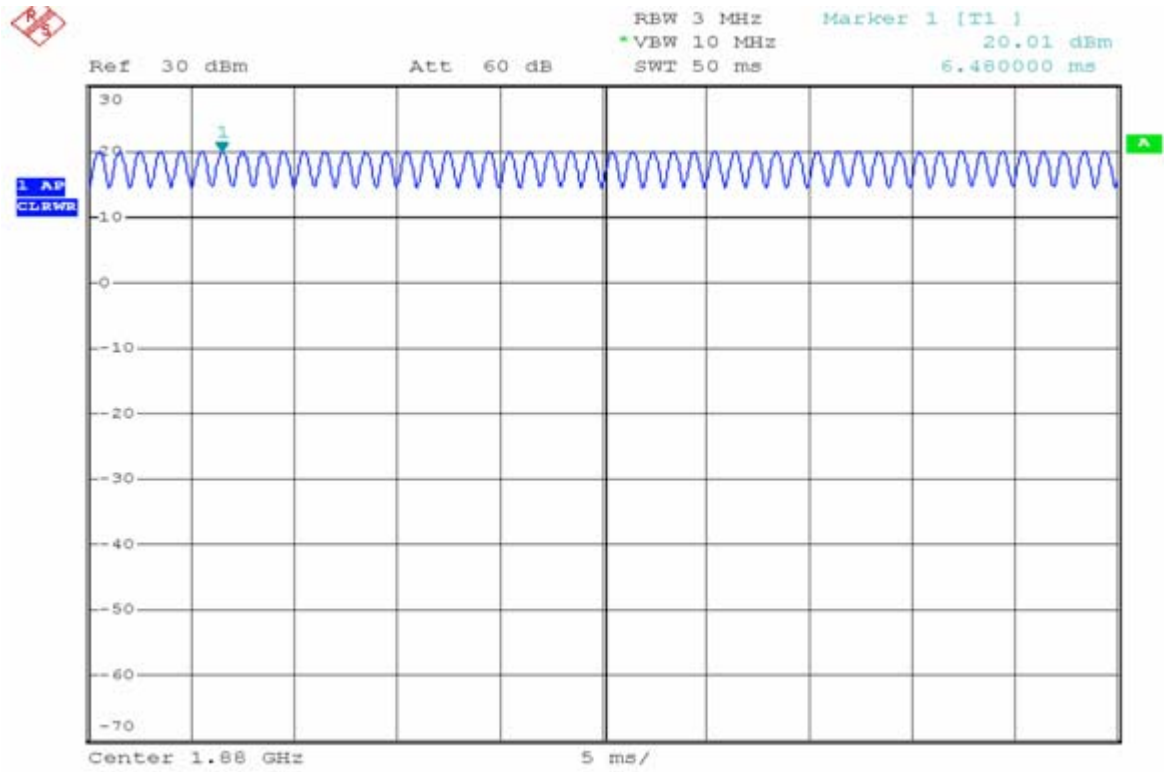
CDMA Signal for 1900MHz band:



CW Signal for 1900MHz band:



80%AM Signal for 1900MHz band:



835 MHz	E-Field (V/m)	H-Field (A/m)	Modulation Factor (MF) for E-field	Modulation Factor (MF) for H-field
CDMA	123.1	0.4793	1.0	1.0
CW	127.4	0.4725		
80%AM	99.52	0.3737		

1880 MHz	E-Field (V/m)	H-Field (A/m)	Modulation Factor (MF) for E-field	Modulation Factor (MF) for H-field
CDMA	146.6	0.6803	1.0	0.7
CW	150.4	0.4717		
80%AM	115.0	0.3723		

10. DETAILED TEST RESULTS

Test Technician / Engineer	Bob Alexander, Anu Balijepalli		
Date of Measurement	19-23 June 2006		
Temperature / Humidity / Pressure	20-22	50-65	29-31
Test Result	Complies		

10.1 Near Field E and H RF emissions measurements

10.1.1 Test Results

CDMA CELLULAR E - FIELD

CDMA CELL	Conducted Power (dBm)	Power Drift (dB)	E (V/m)	Modulation Factor	Excluded Blocks
Ch 1013	23.3	-0.025	92.0	1.0	4,7,8
Ch 384	23.2	-0.288	88.5	1.0	6,8,9
Ch 777	23.3	-0.228	92.1	1.0	6,8,9

CDMA CELLULAR H - FIELD

CDMA CELL	Conducted Power (dBm)	Power Drift (dB)	H (A/m)	Modulation Factor	Excluded Blocks
Ch 1013	23.3	0.320	0.102	1.0	1,4,7
Ch 384	23.2	-0.059	0.154	1.0	1,4,7
Ch 777	23.3	-0.111	0.163	1.0	1,4,7

CDMA PCS E - FIELD

CDMA PCS	Conducted Power (dBm)	Power Drift (dB)	E (V/m)	Modulation Factor	Excluded Blocks
Ch 25	23.0	0.017	54.0	1.0	2,3,6
Ch 600	23.1	-0.080	75.4	1.0	6,8,9
Ch 1175	23..0	-0.119	59.4	1.0	2,3,6

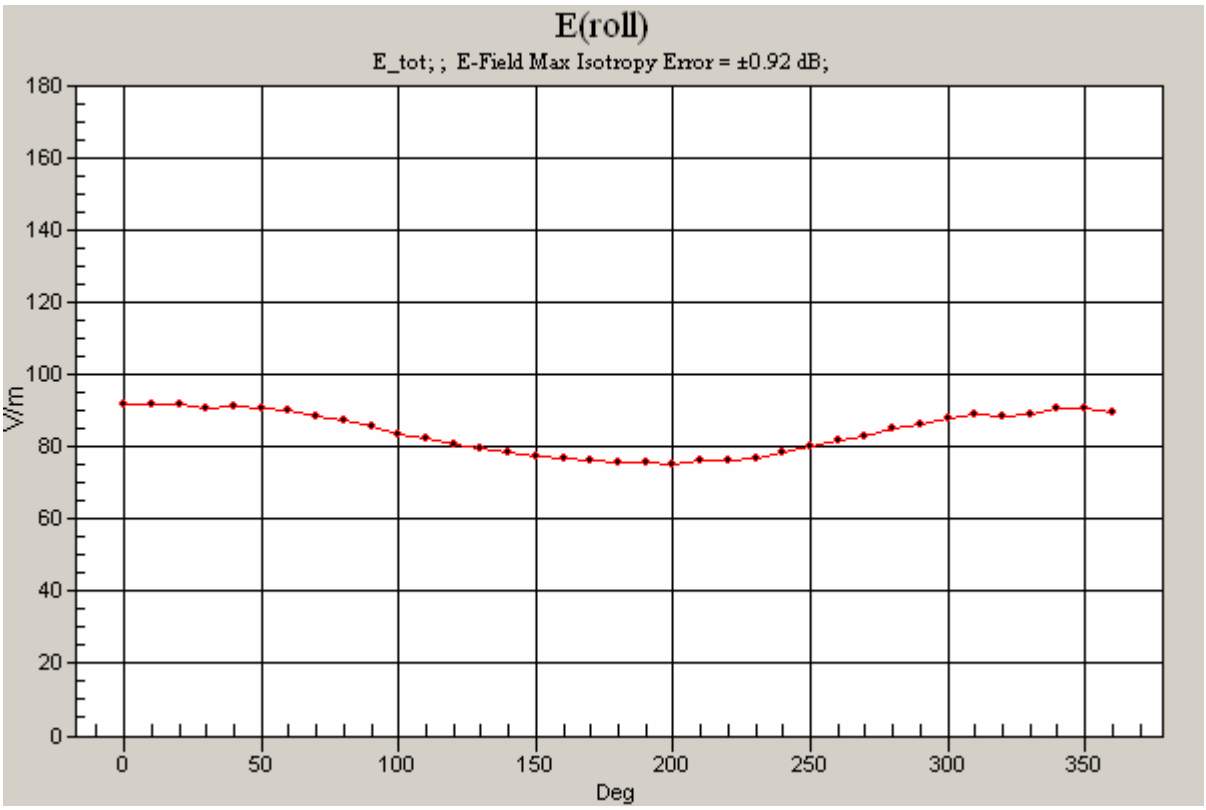
CDMA PCS H - FIELD

CDMA PCS	Conducted Power (dBm)	Power Drift (dB)	H (A/m)	Modulation Factor	Excluded Blocks
Ch 25	23.0	-0.264	0.095	0.7	1,4,7
Ch 600	23.1	-0.207	0.106	0.7	1,4,7
Ch 1175	23..0	0.090	0.110	0.7	1,4,7

WORST CASE CONFIGURATION

CDMA CELL	E (V/m)	Modulation Factor	FCC M3 Limits (V/m)	Category
CDMA 800	91.74	1.0	63.1 to 112.2	M3

The probe rotation was done at the sub grid 5 for Channel 777, E field.



11. MEASUREMENT UNCERTAINTY

HAC Uncertainty Budget									
Error Description	**Uncertainty value**	**Prob. Dist.**	**Div.**	**(ci) E**	**(ci) H**	**Std. Unc. E**	**Std. Unc. H**	**Squared E**	**Squared H**
Measurement System									
Probe Calibration	5.1	N	1	1	1	5.1	5.1	26.0	26.0
Axial Isotropy	4.7	R	1.7321	1	1	2.7	2.7	7.4	7.4
Sensor Displacement	16.5	R	1.7321	1	0.145	9.5	1.4	90.7	1.9
Boundary Effects	2.4	R	1.7321	1	1	1.4	1.4	1.9	1.9
Linearity	4.7	R	1.7321	1	1	2.7	2.7	7.4	7.4
Scaling to Peak Envelope Power	2	R	1.7321	1	1	1.2	1.2	1.3	1.3
System Detection Limit	1	R	1.7321	1	1	0.6	0.6	0.3	0.3
Readout Electronics	0.3	N	1	1	1	0.3	0.3	0.1	0.1
Response Time	0.8	R	1.7321	1	1	0.5	0.5	0.2	0.2
Integration Time	2.6	R	1.7321	1	1	1.5	1.5	2.3	2.3
RF Ambient Conditions	3	R	1.7321	1	1	1.7	1.7	3.0	3.0
RF Reflections	12	R	1.7321	1	1	6.9	6.9	48.0	48.0
Probe Positioner	1.2	R	1.7321	1	0.67	0.7	0.5	0.5	0.2
Probe Positioning	4.7	R	1.7321	1	0.67	2.7	1.8	7.4	3.3
Extrap. And Interpolation	1	R	1.7321	1	1	0.6	0.6	0.3	0.3
Test Sample Related								0.0	0.0
Device Positioning Vertical	10	R	1.7321	1	0.67	2.7	1.8	7.4	3.3
Device Positioning Lateral	10	R	1.7321	1	1	0.6	0.6	0.3	0.3
Device Holder	2.4	R	1.7321	1	1	1.4	1.4	1.9	1.9
Power Drift	5	R	1.7321	1	1	2.9	2.9	8.3	8.3
Phantom and Setup Related								0.0	0.0
Phantom Thickness	2.4	R	1.7321	1	0.67	1.4	0.9	1.9	0.9
Combined Std. Uncertainty								16.6	12.8
Expanded Std. Uncertainty on Field (k=2)								33.2%	21.8%

APPENDIX A: VALIDATIONS SCANS

Date/Time: 6/23/2006 10:24:46 AM
Test Laboratory: TCC Dallas

835MHz, E field, CW Validation

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: ER3DV4R - SN2240; ConvF(1, 1, 1); Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: E Dipole Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

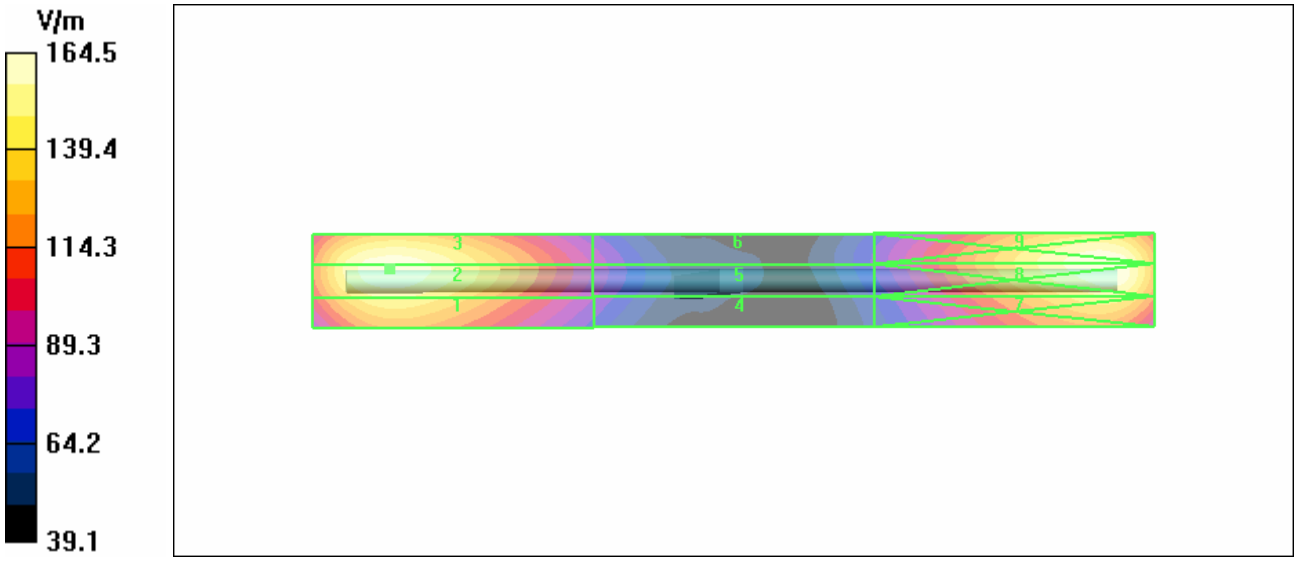
E Scan - ER probe center 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 162.5 V/m
Probe Modulation Factor = 1.00
Reference Value = 103.4 V/m; Power Drift = -0.046 dB

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

Peak E-field in V/m

Grid 1 **149.0**	Grid 2 **162.5**	Grid 3 **161.7**
Grid 4 **82.0**	Grid 5 **88.5**	Grid 6 **88.0**
Grid 7 **147.6**	Grid 8 **164.5**	Grid 9 **164.2**



Date/Time: 6/19/2006 8:56:44 AM
Test Laboratory: TCC Dallas

835MHz, H field, CW Validation

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: H3DV6 - SN6058; ; Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: H Dipole Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

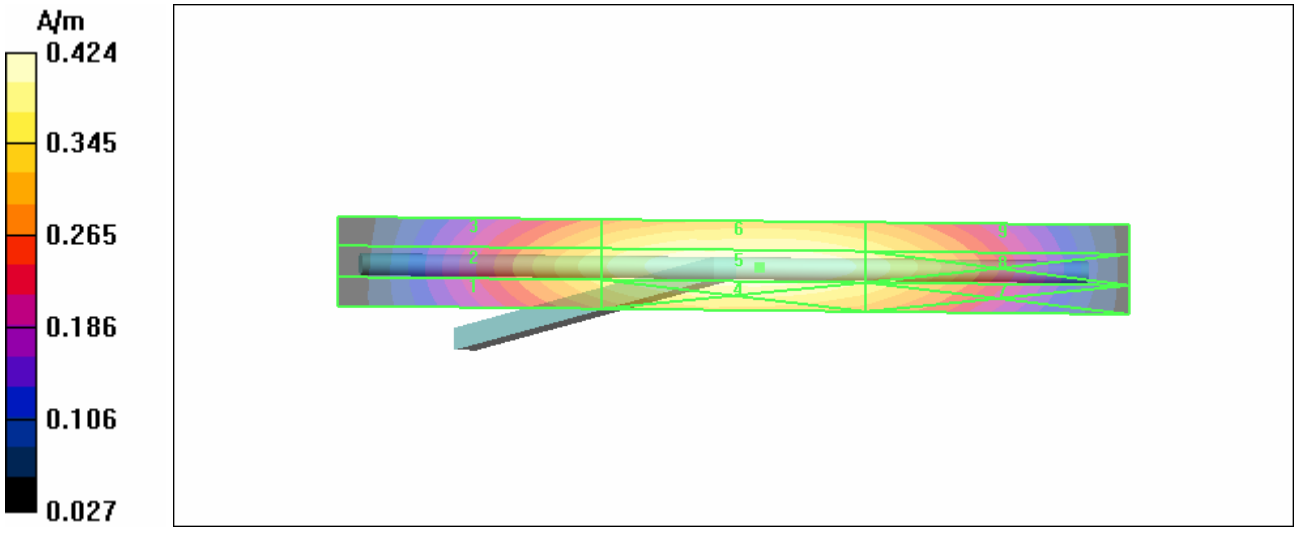
H Scan - H3DV6 probe center 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.424 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.455 A/m; Power Drift = -0.177 dB

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

Peak H-field in A/m

Grid 1 **0.355**	Grid 2 **0.367**	Grid 3 **0.347**
Grid 4 **0.408**	Grid 5 **0.424**	Grid 6 **0.400**
Grid 7 **0.370**	Grid 8 **0.392**	Grid 9 **0.370**



Date/Time: 6/19/2006 9:27:51 AM
Test Laboratory: TCC Dallas

1880MHz, E field, CW Validation

Communication System: CW; Frequency: 1880 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: ER3DV4R - SN2240; ConvF(1, 1, 1); Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: E Dipole Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

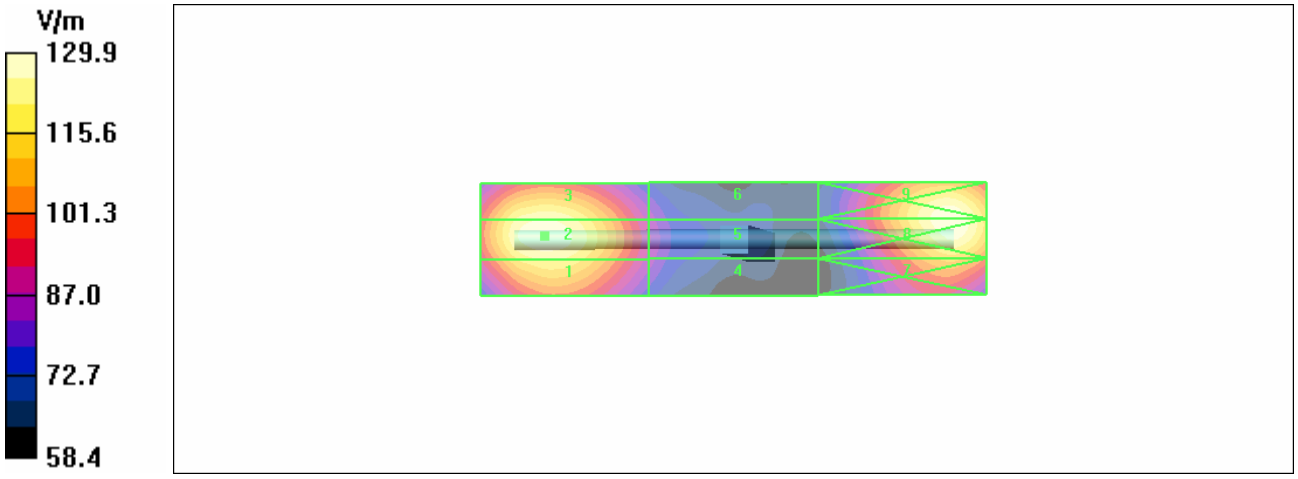
E Scan - ER probe center 10mm above CD1880 Dipole/Hearing Aid Compatibility Test (41x181x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 129.0 V/m
Probe Modulation Factor = 1.00
Reference Value = 141.5 V/m; Power Drift = 0.063 dB

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

Peak E-field in V/m

Grid 1 **121.2**	Grid 2 **129.0**	Grid 3 **125.4**
Grid 4 **85.1**	Grid 5 **88.1**	Grid 6 **85.4**
Grid 7 **113.3**	Grid 8 **129.9**	Grid 9 **129.8**



Date/Time: 6/19/2006 9:39:03 AM
Test Laboratory: TCC Dallas

1880MHz, H field, CW Validation

Communication System: CW; Frequency: 1880 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: H3DV6 - SN6058; ; Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: H Dipole Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

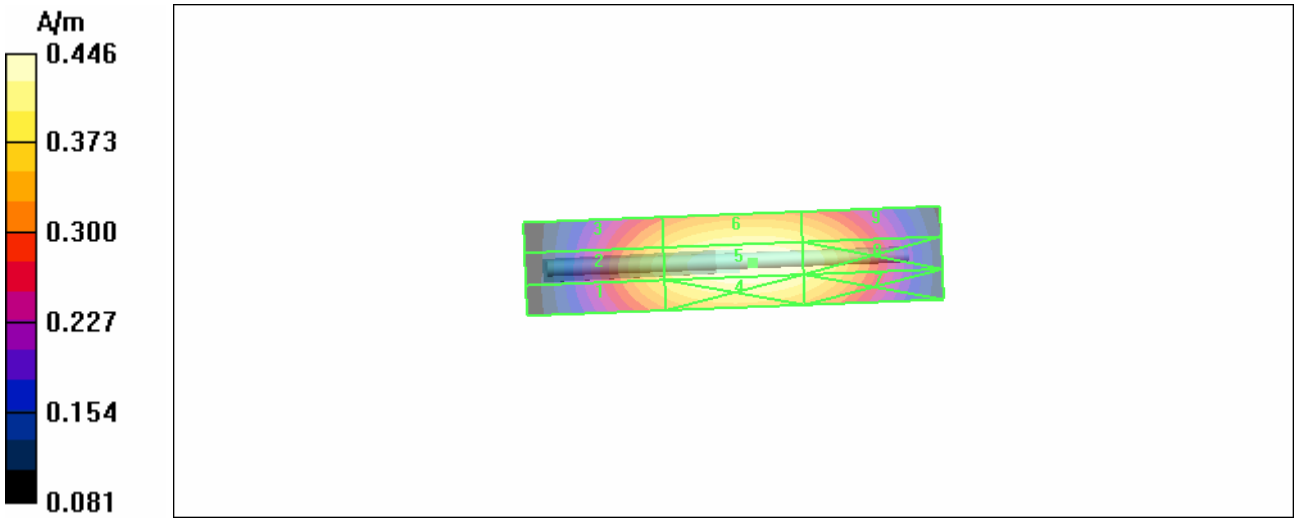
H Scan - H3DV6 probe center 10mm above CD1880 Dipole/Hearing Aid Compatibility Test (41x181x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.446 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.468 A/m; Power Drift = 0.008 dB

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

Peak H-field in A/m

Grid 1 **0.383**	Grid 2 **0.394**	Grid 3 **0.371**
Grid 4 **0.434**	Grid 5 **0.446**	Grid 6 **0.419**
Grid 7 **0.411**	Grid 8 **0.424**	Grid 9 **0.397**



APPENDIX B: MEASUREMENT SCANS

Date/Time: 6/23/2006 11:57:39 AM
Test Laboratory: TCC Dallas

RM-155, CDMA800, Ch1013, E field

Communication System: CDMA800; Frequency: 824.7 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: ER3DV4R - SN2240; ConvF(1, 1, 1); Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: E Device Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

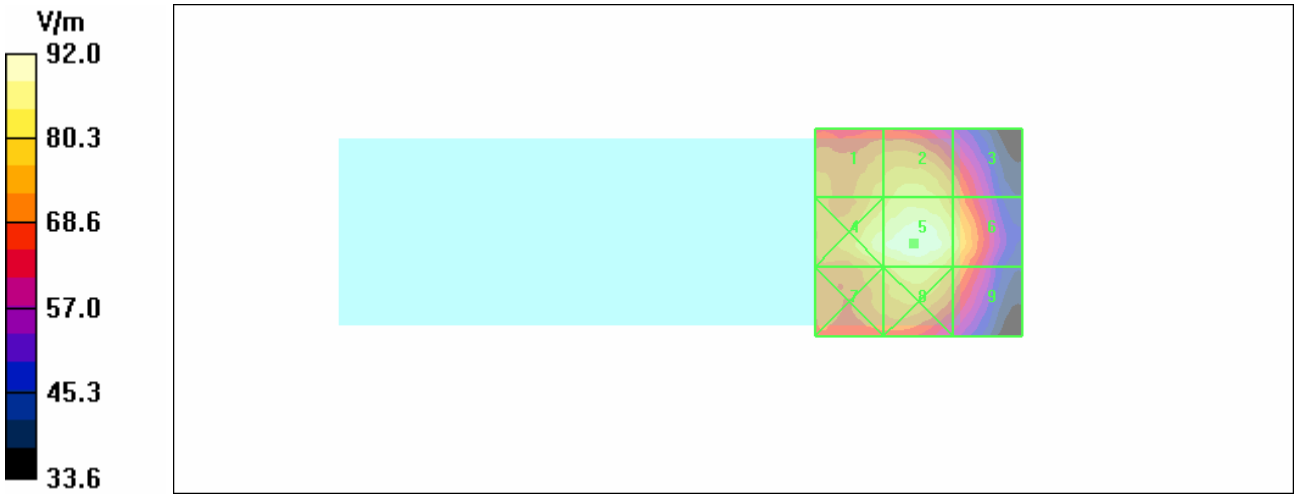
E Scan - ER probe center 10mm above Device Reference/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm

Maximum value of peak Total field = 92.0 V/m
Probe Modulation Factor = 1.00
Reference Value = 91.7 V/m; Power Drift = -0.025 dB

Hearing Aid Near-Field Category: M3 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **79.0**	Grid 2 **82.7**	Grid 3 **74.7**
Grid 4 **87.9**	Grid 5 **92.0**	Grid 6 **83.7**
Grid 7 **79.2**	Grid 8 **83.2**	Grid 9 **76.2**



Date/Time: 6/23/2006 10:40:31 AM
Test Laboratory: TCC Dallas

RM-155, CDMA800, Ch384, E field

Communication System: CDMA800; Frequency: 836.52 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: ER3DV4R - SN2240; ConvF(1, 1, 1); Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: E Device Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

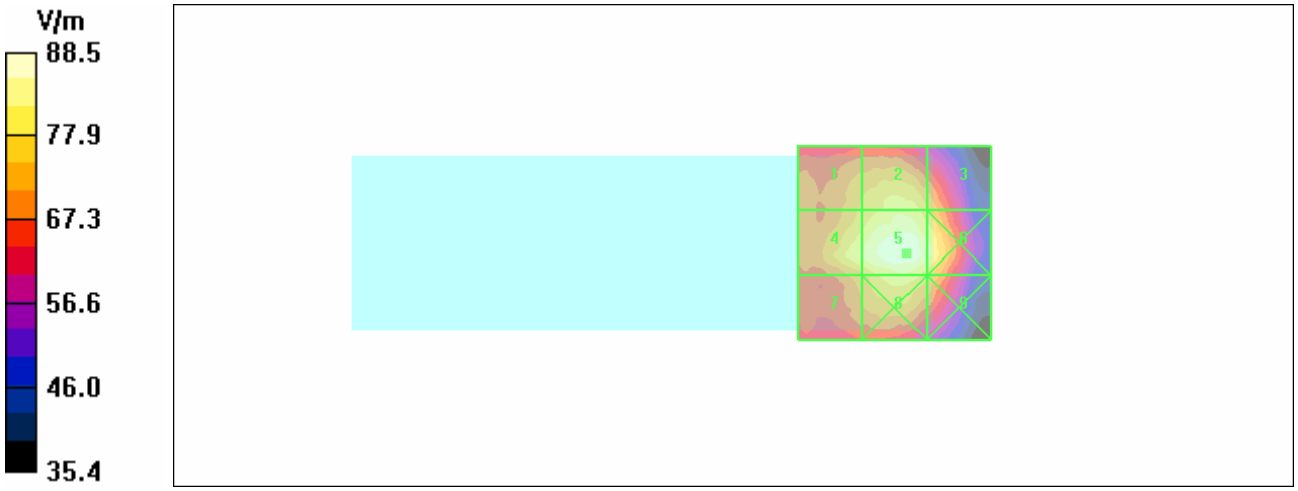
E Scan - ER probe center 10mm above Device Reference/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm

Maximum value of peak Total field = 88.5 V/m
Probe Modulation Factor = 1.00
Reference Value = 89.3 V/m; Power Drift = -0.288 dB

Hearing Aid Near-Field Category: M3 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **75.1**	Grid 2 **80.9**	Grid 3 **75.4**
Grid 4 **82.1**	Grid 5 **88.5**	Grid 6 **83.4**
Grid 7 **73.8**	Grid 8 **80.9**	Grid 9 **76.2**



Date/Time: 6/23/2006 1:07:11 PM
Test Laboratory: TCC Dallas

RM-155, CDMA800, Ch777, E field

Communication System: CDMA800; Frequency: 848.31 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: ER3DV4R - SN2240; ConvF(1, 1, 1); Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: E Device Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

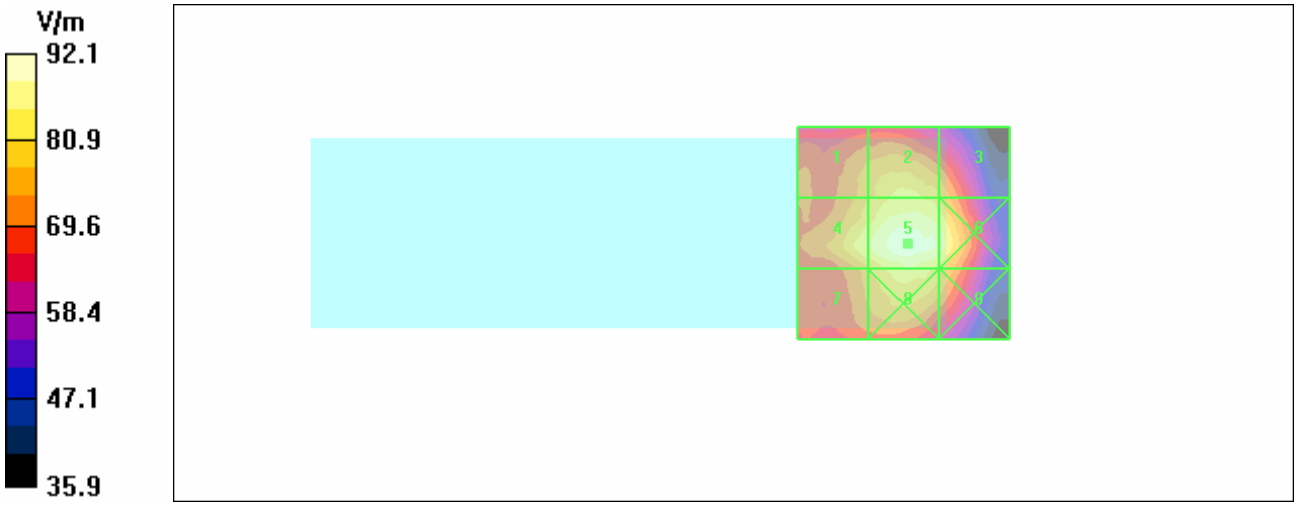
E Scan - ER probe center 10mm above Device Reference/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm

Maximum value of peak Total field = 92.1 V/m
Probe Modulation Factor = 1.00
Reference Value = 92.6 V/m; Power Drift = -0.228 dB

Hearing Aid Near-Field Category: M3 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **76.9**	Grid 2 **82.5**	Grid 3 **77.8**
Grid 4 **84.6**	Grid 5 **92.1**	Grid 6 **87.0**
Grid 7 **76.4**	Grid 8 **84.8**	Grid 9 **78.8**



Date/Time: 6/22/2006 7:48:49 AM
Test Laboratory: TCC Dallas

RM-155, CDMA800, Ch1013, H field

Communication System: CDMA800; Frequency: 824.7 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: H3DV6 - SN6058; ; Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: H Device Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

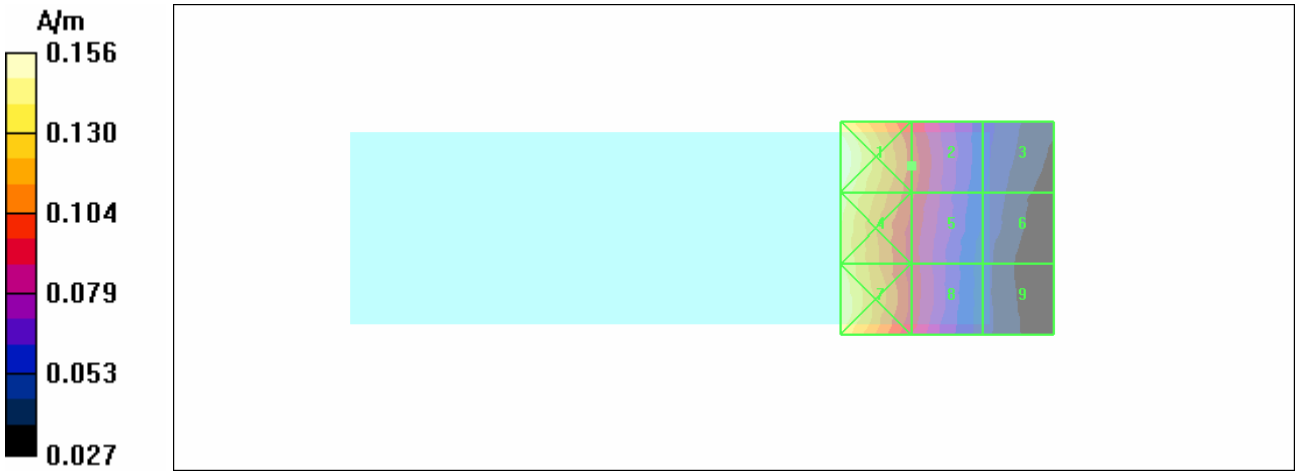
H Scan - H3DV6 probe center 10mm above Device Reference/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm

Maximum value of peak Total field = 0.102 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.071 A/m; Power Drift = 0.320 dB

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

Peak H-field in A/m

Grid 1 **0.156**	Grid 2 **0.102**	Grid 3 **0.058**
Grid 4 **0.147**	Grid 5 **0.099**	Grid 6 **0.054**
Grid 7 **0.148**	Grid 8 **0.094**	Grid 9 **0.049**



Date/Time: 6/22/2006 7:24:53 AM
Test Laboratory: TCC Dallas

RM-155, CDMA800, Ch384, H field

Communication System: CDMA800; Frequency: 836.52 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: H3DV6 - SN6058; ; Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: H Device Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

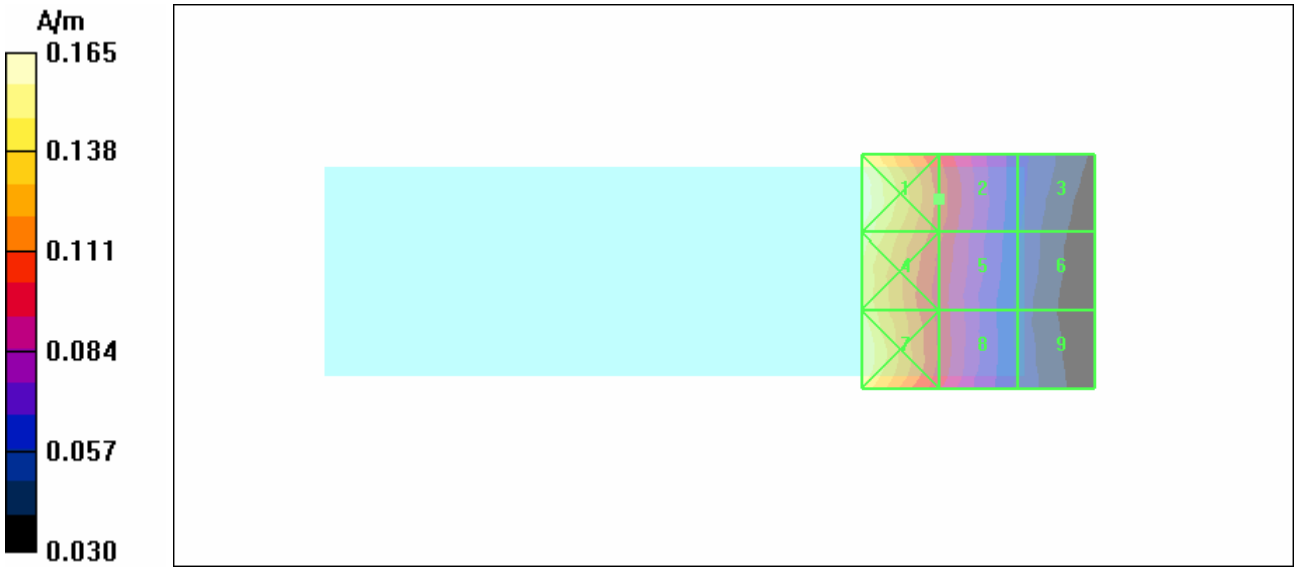
H Scan - H3DV6 probe center 10mm above Device Reference/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm

Maximum value of peak Total field = 0.108 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.078 A/m; Power Drift = -0.059 dB

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

Peak H-field in A/m

Grid 1 **0.165**	Grid 2 **0.108**	Grid 3 **0.062**
Grid 4 **0.154**	Grid 5 **0.105**	Grid 6 **0.059**
Grid 7 **0.157**	Grid 8 **0.102**	Grid 9 **0.057**



Date/Time: 6/22/2006 8:21:41 AM
Test Laboratory: TCC Dallas

RM-155, CDMA800, Ch777, H field

Communication System: CDMA800; Frequency: 848.31 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: H3DV6 - SN6058; ; Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: H Device Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

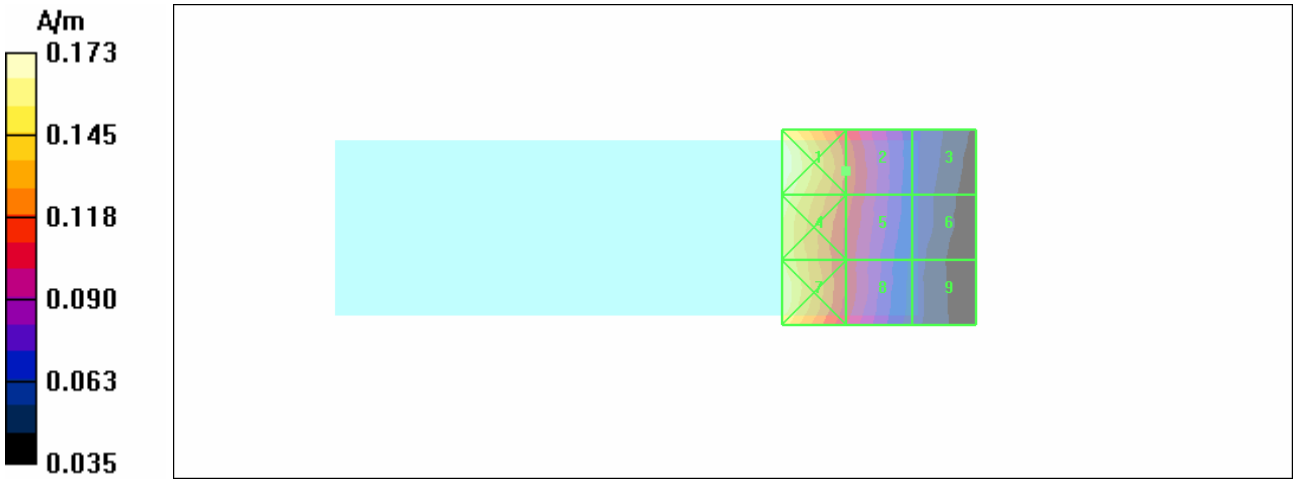
H Scan - H3DV6 probe center 10mm above Device Reference/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm

Maximum value of peak Total field = 0.117 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.086 A/m; Power Drift = -0.111 dB

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

Peak H-field in A/m

Grid 1 **0.173**	Grid 2 **0.117**	Grid 3 **0.068**
Grid 4 **0.163**	Grid 5 **0.114**	Grid 6 **0.066**
Grid 7 **0.163**	Grid 8 **0.108**	Grid 9 **0.061**



Date/Time: 6/22/2006 12:22:39 PM
Test Laboratory: TCC Dallas

RM-155, CDMA1900, Ch25, E field

Communication System: CDMA1900; Frequency: 1851.25 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: ER3DV4R - SN2240; ConvF(1, 1, 1); Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: E Device Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

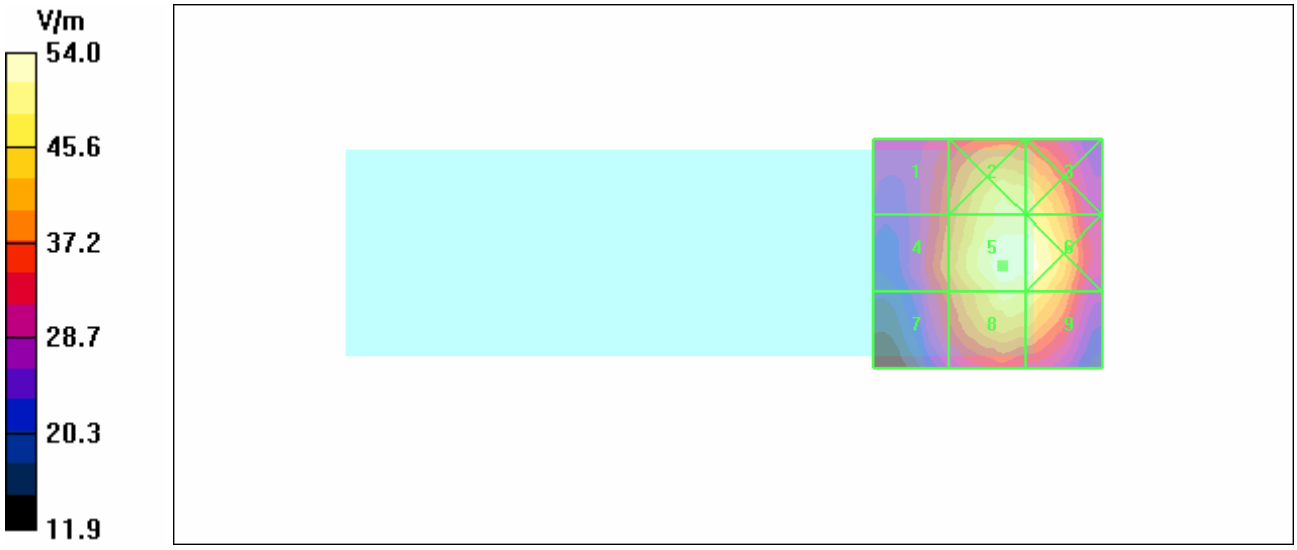
E Scan - ER probe center 10mm above Device Reference/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm

Maximum value of peak Total field = 54.0 V/m
Probe Modulation Factor = 1.00
Reference Value = 50.8 V/m; Power Drift = 0.017 dB

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

Peak E-field in V/m

Grid 1 **37.6**	Grid 2 **50.4**	Grid 3 **49.3**
Grid 4 **40.4**	Grid 5 **54.0**	Grid 6 **53.6**
Grid 7 **36.8**	Grid 8 **49.8**	Grid 9 **49.0**



Date/Time: 6/22/2006 11:40:26 AM
Test Laboratory: TCC Dallas

RM-155, CDMA1900, Ch600, E field

Communication System: CDMA1900; Frequency: 1880 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: ER3DV4R - SN2240; ConvF(1, 1, 1); Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: E Device Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

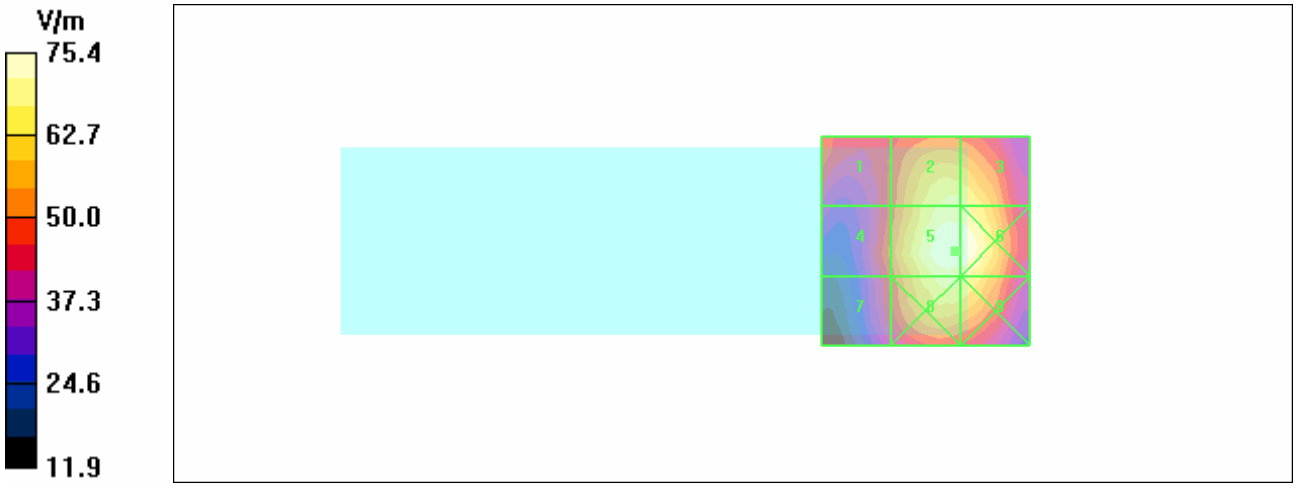
E Scan - ER probe center 10mm above Device Reference/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm

Maximum value of peak Total field = 75.4 V/m
Probe Modulation Factor = 1.00
Reference Value = 68.6 V/m; Power Drift = -0.080 dB

Hearing Aid Near-Field Category: M3 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **49.8**	Grid 2 **68.9**	Grid 3 **68.5**
Grid 4 **51.6**	Grid 5 **75.4**	Grid 6 **75.0**
Grid 7 **47.7**	Grid 8 **69.4**	Grid 9 **68.7**



Date/Time: 6/22/2006 1:07:46 PM
Test Laboratory: TCC Dallas

RM-155, CDMA1900, Ch1175, E field

Communication System: CDMA1900; Frequency: 1908.75 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: ER3DV4R - SN2240; ConvF(1, 1, 1); Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: E Device Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

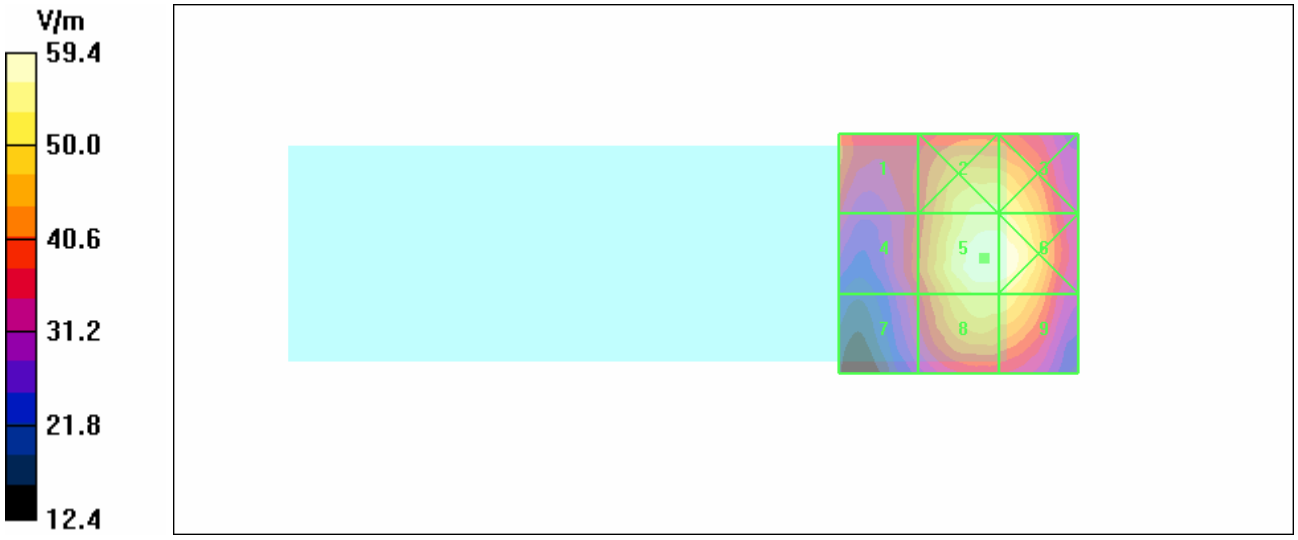
E Scan - ER probe center 10mm above Device Reference/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm

Maximum value of peak Total field = 59.4 V/m
Probe Modulation Factor = 1.00
Reference Value = 55.9 V/m; Power Drift = -0.119 dB

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

Peak E-field in V/m

Grid 1 **42.4**	Grid 2 **54.3**	Grid 3 **54.0**
Grid 4 **40.6**	Grid 5 **59.4**	Grid 6 **58.9**
Grid 7 **36.8**	Grid 8 **53.4**	Grid 9 **53.4**



Date/Time: 6/22/2006 9:18:44 AM
Test Laboratory: TCC Dallas

RM-155, CDMA1900, Ch25, H field

Communication System: CDMA1900; Frequency: 1851.25 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: H3DV6 - SN6058; ; Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: H Device Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

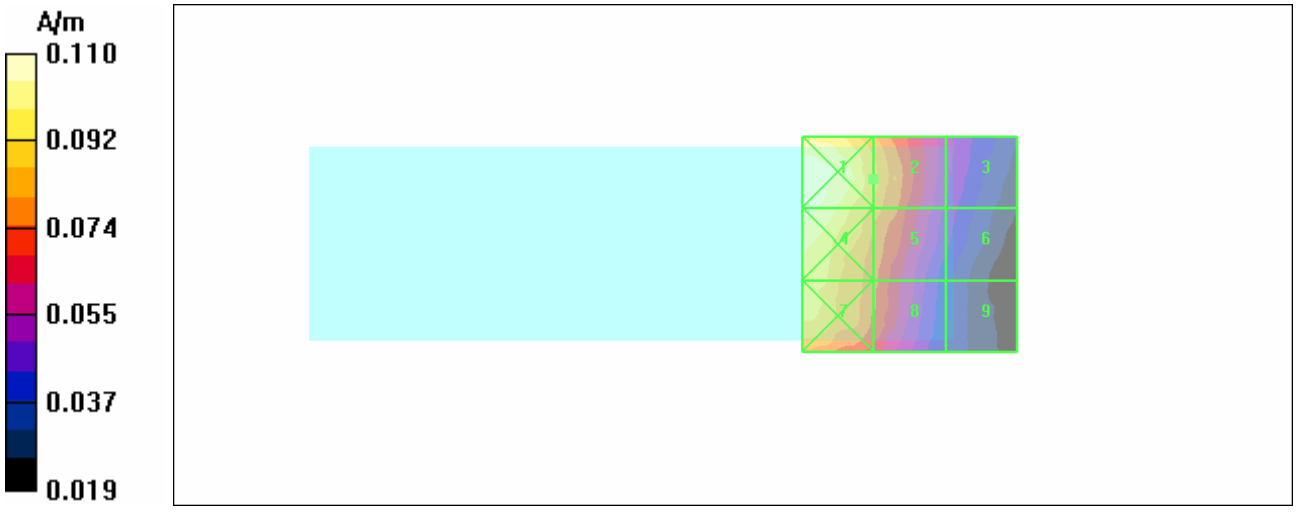
H Scan - H3DV6 probe center 10mm above Device Reference/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm

Maximum value of peak Total field = 0.088 A/m
Probe Modulation Factor = 0.700
Reference Value = 0.090 A/m; Power Drift = -0.264 dB

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

Peak H-field in A/m

Grid 1 **0.110**	Grid 2 **0.088**	Grid 3 **0.052**
Grid 4 **0.105**	Grid 5 **0.084**	Grid 6 **0.049**
Grid 7 **0.095**	Grid 8 **0.075**	Grid 9 **0.040**



Date/Time: 6/22/2006 8:56:20 AM
Test Laboratory: TCC Dallas

RM-155, CDMA1900, Ch600, H field

Communication System: CDMA1900; Frequency: 1880 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: H3DV6 - SN6058; ; Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: H Device Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

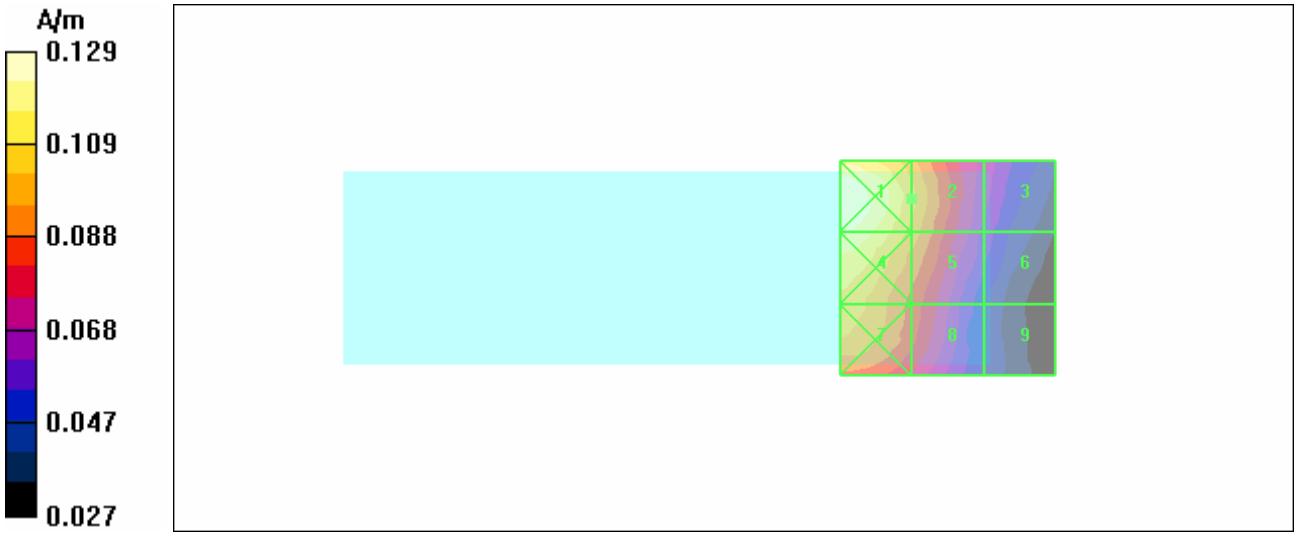
H Scan - H3DV6 probe center 10mm above Device Reference/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm

Maximum value of peak Total field = 0.104 A/m
Probe Modulation Factor = 0.700
Reference Value = 0.105 A/m; Power Drift = -0.207 dB

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

Peak H-field in A/m

Grid 1 **0.129**	Grid 2 **0.104**	Grid 3 **0.065**
Grid 4 **0.122**	Grid 5 **0.099**	Grid 6 **0.059**
Grid 7 **0.106**	Grid 8 **0.086**	Grid 9 **0.049**



Date/Time: 6/22/2006 10:22:45 AM
Test Laboratory: TCC Dallas

RM-155, CDMA1900, Ch1175, H field

Communication System: CDMA1900; Frequency: 1908.75 MHz;Duty Cycle: 1:1
DASY4 Configuration:
- Probe: H3DV6 - SN6058; ; Calibrated: 1/24/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn389; Calibrated: 1/20/2006
- Phantom: HAC Test Arch 4.6; Phantom section: H Device Section
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

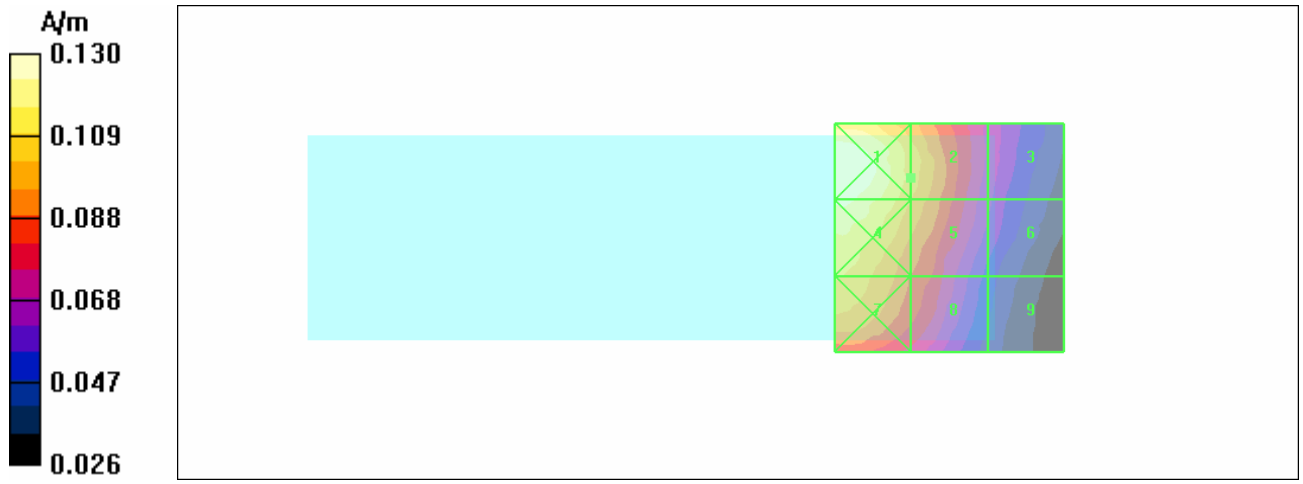
H Scan - H3DV6 probe center 10mm above Device Reference/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm

Maximum value of peak Total field = 0.107 A/m
Probe Modulation Factor = 0.700
Reference Value = 0.111 A/m; Power Drift = 0.090 dB

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

Peak H-field in A/m

Grid 1 **0.130**	Grid 2 **0.107**	Grid 3 **0.067**
Grid 4 **0.125**	Grid 5 **0.103**	Grid 6 **0.063**
Grid 7 **0.110**	Grid 8 **0.088**	Grid 9 **0.052**



APPENDIX C: PROBE CALIBRATION REPORTS AND DIPOLE CALIBRATION REPORTS

ACCREDITED

Accredited Laboratory Certificate
Number: 1819-01

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

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

Accredited by the Swiss Federal Office of Metrology and Accreditation
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 **Nokia TX**

Certificate No: **CD1880V3-1045_Nov05**

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1045
Calibration procedure(s)	QA CAL-20.v3 Calibration procedure for dipoles in air
Calibration date:	November 4, 2005
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	04-Oct-05 (METAS, No. 251-00516)	Oct-06
Power sensor HP 8481A	US37292783	04-Oct-05 (METAS, No. 251-00516)	Oct-06
20 dB Attenuator	SN: 5086 (20g)	11-Aug-05 (METAS, No 251-00498)	Aug-06
10 dB Attenuator	SN: 5047.2 (10r)	11-Aug-05 (METAS, No 251-00498)	Aug-06

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-4419B	GB43310788	12-Aug-03 (SPEAG, in house check Oct-05)	In house check: Oct-06
Power sensor HP 8481A	MY41093312	10-Aug-03 (SPEAG, in house check Oct-05)	In house check: Oct-07
Power sensor HP 8481A	MY41093315	10-Aug-03 (SPEAG, in house check Oct-05)	In house check: Oct-06
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov-05
RF generator R&S SMT06	SN: 100005	26-Jul-04 (SPEAG, in house check Jul-04)	In house check: Jan-06
DAE4	SN: 660	16-Dec-04 (SPEAG, No. DAE4-660_Dec04)	Calibration, Dec-05
Probe ER3DV6	SN: 2336	20-Jan-05 (SPEAG, No. ER3-2336_Jan05)	Calibration, Jan-06
Probe H3DV6	SN: 6065	10-Dec-04 (SPEAG, No. H3-6065-Dec04)	Calibration, Dec-05

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

Issued: December 9, 2005

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

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

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S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Federal Office of Metrology and Accreditation
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-PC63.19-2001 (Draft 3.x, 2005)
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

Methods Applied and Interpretation of Parameters:

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

1 Measurement Conditions

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

DASY Version	DASY4	V4.6 B23
DASY PP Version	SEMCAD	V1.8 B160
Phantom	HAC Test Arch	SD HAC P01 BA, #1002
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 90 mm
Frequency	**1880 MHz** ± 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	**interpolated maximum**
Maximum measured	100 mW forward power	**0.447 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	136.2 V/m
Maximum measured above low end	100 mW forward power	132.1 V/m
Averaged maximum above arm	100 mW forward power	**134.2 V/m**

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

3 Appendix

3.1 Antenna Parameters

Frequency	**Return Loss**	**Impedance**
1710 MHz	19.9 dB	(56.1 + j8.9) Ohm
1880 MHz	**21.1 dB**	**(57.9+ j5.3 Ohm**
1900 MHz	21.0 dB	(59.4 + j2.9) Ohm
1950 MHz	27.5 dB	(52.7 – j3.4) Ohm
2000 MHz	21.1 dB	(44.8 + j6.6) Ohm

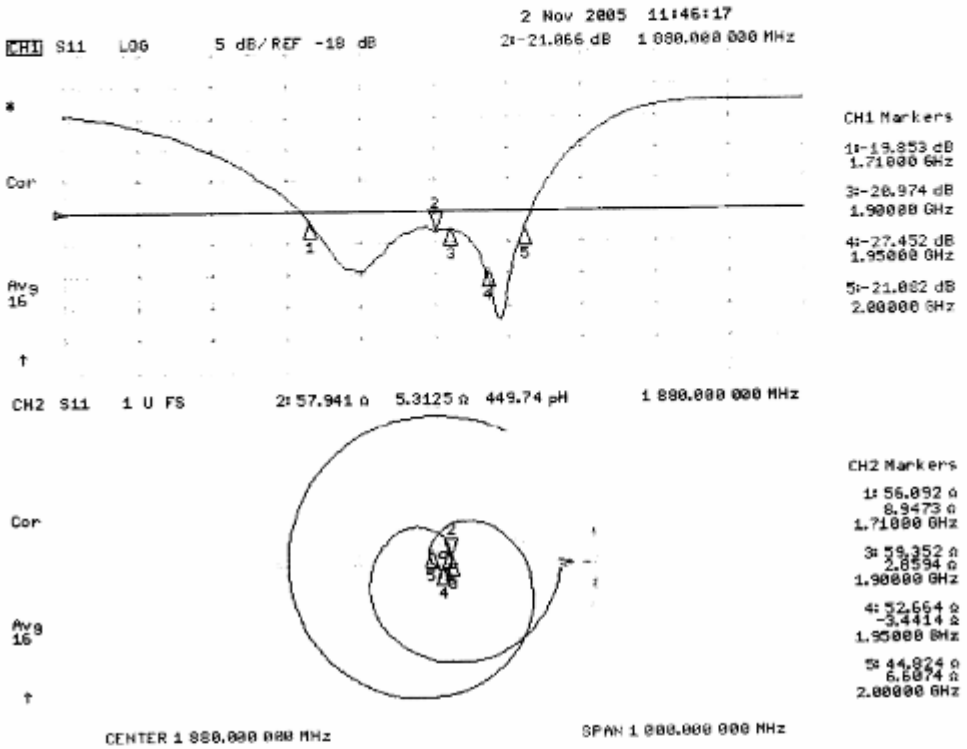
3.2 Antenna Design and Handling

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: 11/4/2005 11:39:29 AM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1045

Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: Air
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: H Dipole Section

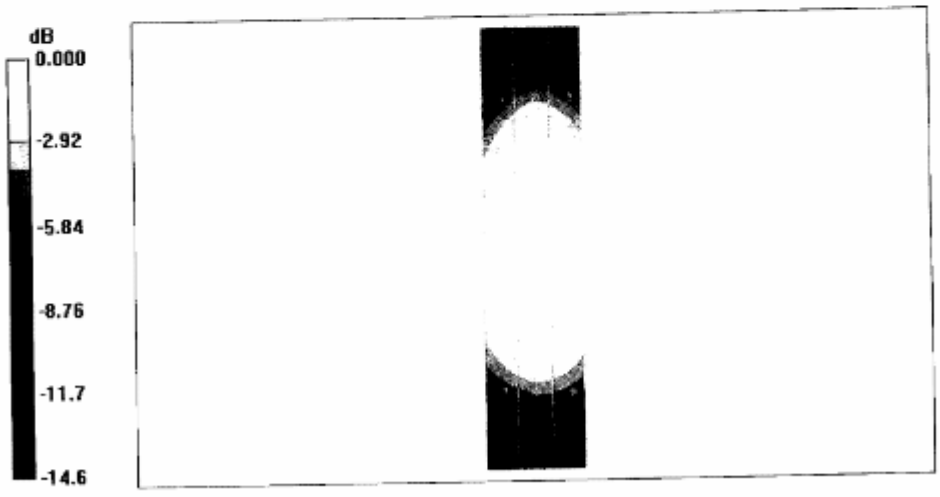
DASY4 Configuration:

- Probe: H3DV6 - SN6065; Calibrated: 12/10/2004
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 12/16/2004
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

H Scan 10mm above CD1880V3/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.447 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.137 A/m; Power Drift = -0.031 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1	Grid 2	Grid 3
0.388	**0.419**	**0.407**
Grid 4	Grid 5	Grid 6
0.418	**0.447**	**0.435**
Grid 7	Grid 8	Grid 9
0.380	**0.404**	**0.392**



0 dB = 0.447A/m

3.3.3 DASY4 E-Field result

Date/Time: 11/4/2005 3:59:53 PM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1045

Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: Air
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Dipole Section

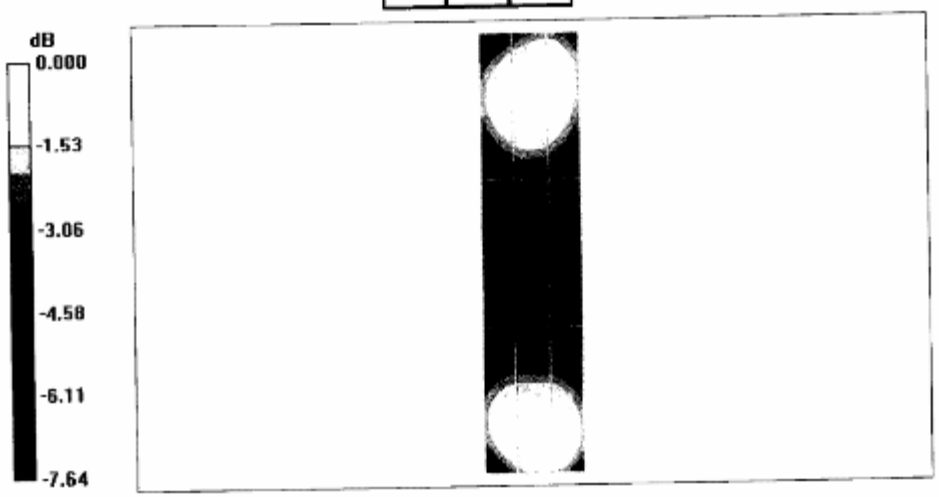
DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 1/20/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 12/16/2004
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

E Scan 10mm above CD1880V3/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 136.2 V/m
Probe Modulation Factor = 1.00
Reference Value = 152.2 V/m; Power Drift = 0.019 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1	Grid 2	Grid 3
127.4	**132.1**	**130.2**
Grid 4	Grid 5	Grid 6
86.3	**88.5**	**85.7**
Grid 7	Grid 8	Grid 9
129.5	**136.2**	**133.7**



0 dB = 136.2V/m

Accredited Laboratory Certificate
Number: 1819-01

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S Swiss Calibration Service

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

Accreditation No.: SCS 108

Client **Nokia TX**

Certificate No: CD835V3-1055_Dec05

CALIBRATION CERTIFICATE

Object	CD835V3 - SN: 1055
Calibration procedure(s)	QA CAL-20.v4 Calibration procedure for dipoles in air
Calibration date:	December 5, 2005
Condition of the calibrated item	In Tolerance

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	04-Oct-05 (METAS, No. 251-00516)	Oct-06
Power sensor HP 8481A	US37292783	04-Oct-05 (METAS, No. 251-00516)	Oct-06
Reference 20 dB Attenuator	SN: 5086 (20g)	11-Aug-05 (METAS, No 251-00498)	Aug-06
Reference 10 dB Attenuator	SN: 5047.2 (10r)	11-Aug-05 (METAS, No 251-00498)	Aug-06
Secondary Standards	**ID #**	**Check Date (In house)**	**Scheduled Check**
Power meter EPM-4419B	GB43310788	12-Aug-03 (SPEAG, in house check Oct-05)	In house check: Oct-06
Power sensor HP 8481A	MY41093312	10-Aug-03 (SPEAG, in house check Oct-05)	In house check: Oct-07
Power sensor HP 8481A	MY41093315	10-Aug-03 (SPEAG, in house check Oct-05)	In house check: Oct-06
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-05)	In house check: Nov-06
RF generator R&S SMT06	SN: 100005	26-Jul-04 (SPEAG, in house check Nov-05)	In house check: Nov-07
DAE4	SN: 660	16-Dec-04 (SPEAG, No. DAE4-901_Dec04)	Calibration, Dec-05
Probe ER3DV6	SN: 2336	20-Jan-05 (SPEAG, No. ER3-2336_Jan05)	Calibration, Jan-06
Probe H3DV6	SN: 6065	10-Dec-04 (SPEAG, No. H3-6065-Dec04)	Calibration, Dec-05

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

Issued: December 13, 2005

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

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

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

Accredited by the Swiss Federal Office of Metrology and Accreditation
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-PC63.19-2001 (Draft 3.x, 2005)
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

Methods Applied and Interpretation of Parameters:

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

1 Measurement Conditions

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

DASY Version	DASY4	V4.6 B23
DASY PP Version	SEMCAD	V1.8 B160
Phantom	HAC Test Arch	SD HAC P01 BA, #1002
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 180 mm
Frequency	**835 MHz** ± 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured	100 mW forward power	**0.448 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	163.7 V/m
Maximum measured above low end	100 mW forward power	163.3 V/m
Averaged maximum above arm	100 mW forward power	**163.5 V/m**

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

3 Appendix

3.1 Antenna Parameters

Frequency	**Return Loss**	**Impedance**
800 MHz	17.0 dB	(40.6 – j8.9) Ohm
835 MHz	**25.1 dB**	**(53.0 + j4.9) Ohm**
900 MHz	16.7 dB	(50.6 – j14.8) Ohm
950 MHz	21.2 dB	(49.9 + j8.7) Ohm
960 MHz	16.2 dB	(60.5 + j13.7) Ohm

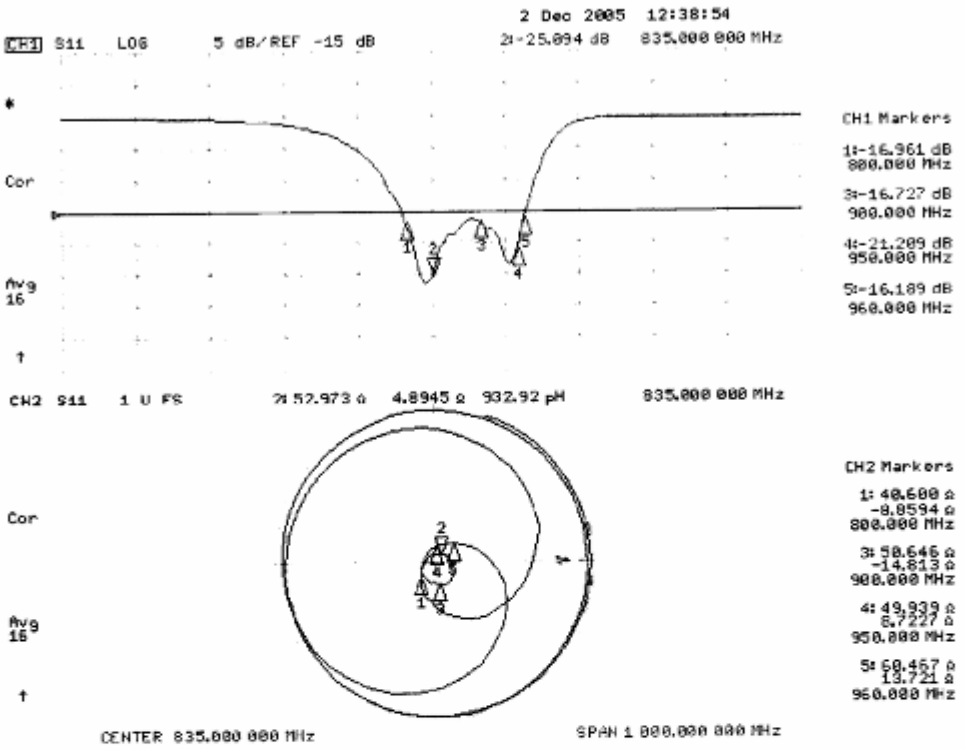
3.2 Antenna Design and Handling

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: 12/5/2005 5:16:26 PM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1055

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: Air
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: H Dipole Section

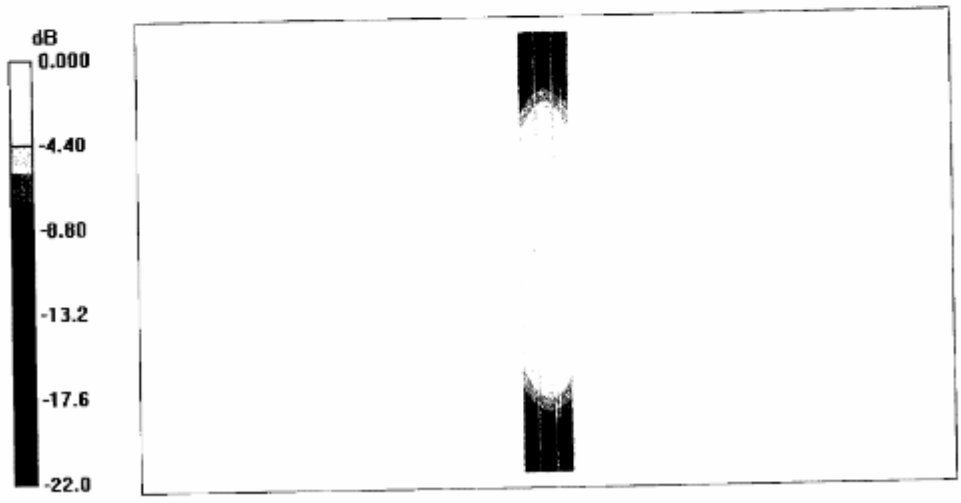
DASY4 Configuration:

- Probe: H3DV6 - SN6065; Calibrated: 12/10/2004
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 12/16/2004
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

H Scan 10mm above CD 835 MHz/Hearing Aid Compatibility Test (41x361x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.448 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.474 A/m; Power Drift = -0.002 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1	Grid 2	Grid 3
0.380	**0.404**	**0.385**
Grid 4	Grid 5	Grid 6
0.420	**0.448**	**0.429**
Grid 7	Grid 8	Grid 9
0.362	**0.387**	**0.374**



0 dB = 0.448A/m

3.3.3 DASY4 E-Field result

Date/Time: 12/5/2005 2:38:39 PM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1055

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: Air
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Dipole Section

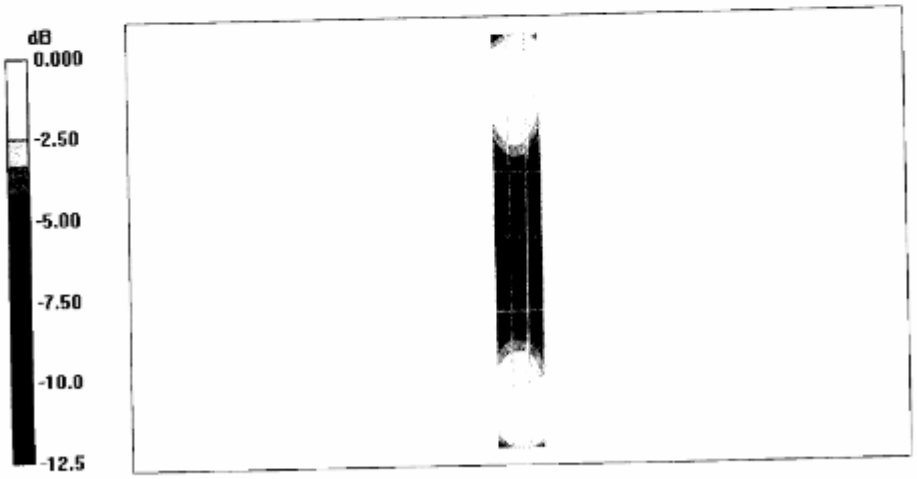
DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 1/20/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 12/16/2004
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

E Scan 10mm above CD 835 MHz/Hearing Aid Compatibility Test (41x361x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 163.7 V/m
Probe Modulation Factor = 1.00
Reference Value = 105.9 V/m; Power Drift = -0.039 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **160.2**	Grid 2 **163.3**	Grid 3 **157.9**
Grid 4 **86.6**	Grid 5 **88.3**	Grid 6 **84.8**
Grid 7 **158.0**	Grid 8 **163.7**	Grid 9 **158.7**



0 dB = 163.7V/m

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Accreditation No.: SCS 108

Client **Nokia TX** Certificate No: **ER3-2240_Jan06**

CALIBRATION CERTIFICATE

Object	ER3DV4R - SN:2240
Calibration procedure(s)	QA CAL-02.v4 Calibration procedure for E-field probes optimized for close near field evaluations in air
Calibration date:	January 24, 2006
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4418B	GB41293874	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41495277	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41498087	3-May-05 (METAS, No. 251-00466)	May-06
Reference 3 dB Attenuator	SN: S5054 (3c)	11-Aug-05 (METAS, No. 251-00499)	Aug-06
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-05 (METAS, No. 251-00467)	May-06
Reference 30 dB Attenuator	SN: S5129 (30b)	11-Aug-05 (METAS, No. 251-00500)	Aug-06
Reference Probe ER3DV6	SN: 2328	3-Oct-05 (SPEAG, No. ER3-2328_Oct05)	Oct-06
DAE4	SN: 654	27-Oct-05 (SPEAG, No. DAE4-654_Oct05)	Oct-06

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

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

Issued: January 24, 2006

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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 108**

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ER3DV4R

SN:2240

Manufactured:	October 1, 1999
Last calibrated:	January 20, 2005
Recalibrated:	January 24, 2006

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ER3DV4R SN:2240 January 24, 2006

DASY - Parameters of Probe: ER3DV4R SN:2240

Sensitivity in Free Space [μV/(V/m)²]

NormX	**2.89** ± 10.1 % (k=2)
NormY	**2.72** ± 10.1 % (k=2)
NormZ	**6.22** ± 10.1 % (k=2)

Diode Compression[A]

DCP X	**92** mV
DCP Y	**92** mV
DCP Z	**93** 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

18 °

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

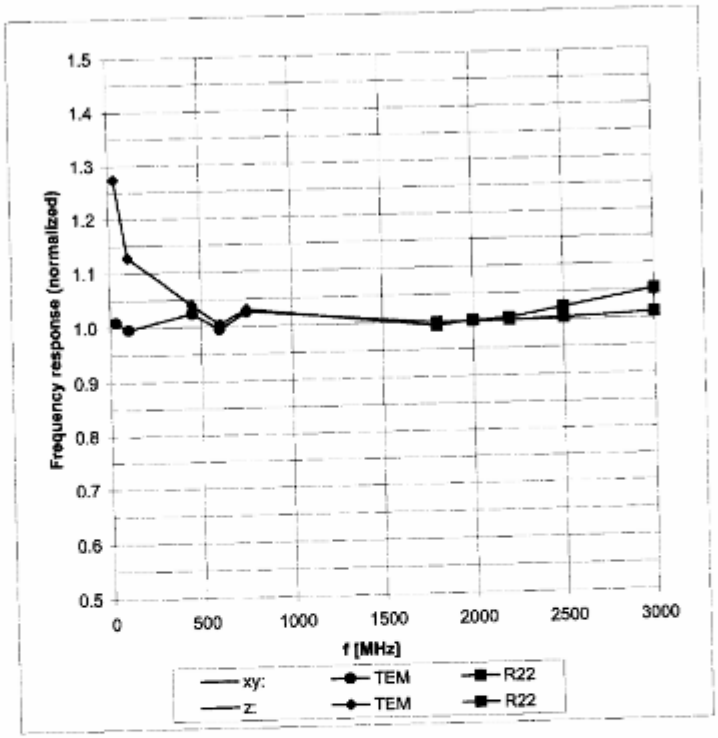
[A] numerical linearization parameter: uncertainty not required

ER3DV4R SN:2240

January 24, 2006

Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide R22)

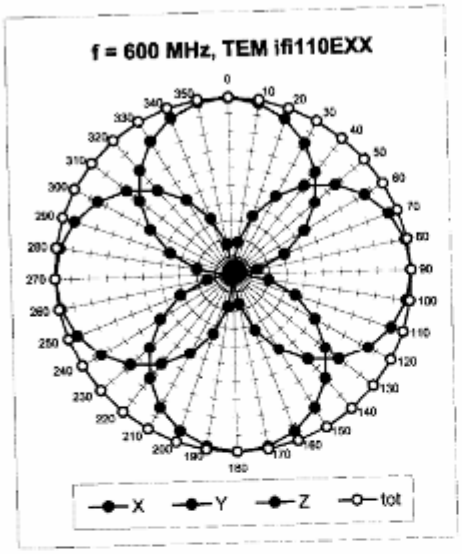


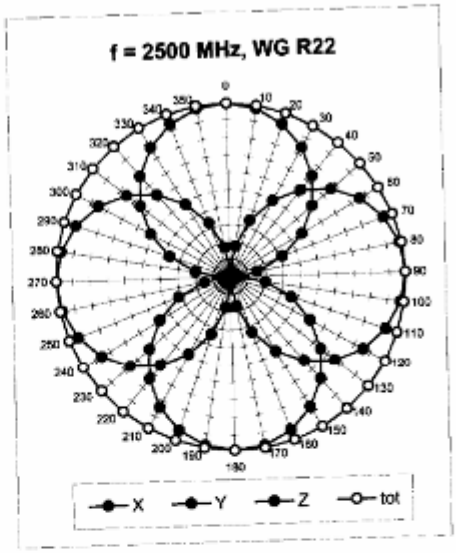
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

ER3DV4R SN:2240

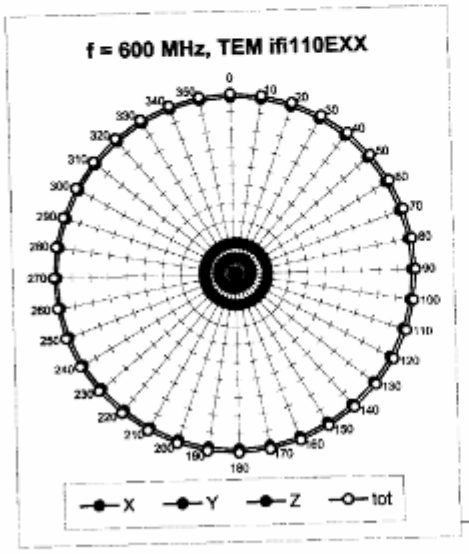
January 24, 2006

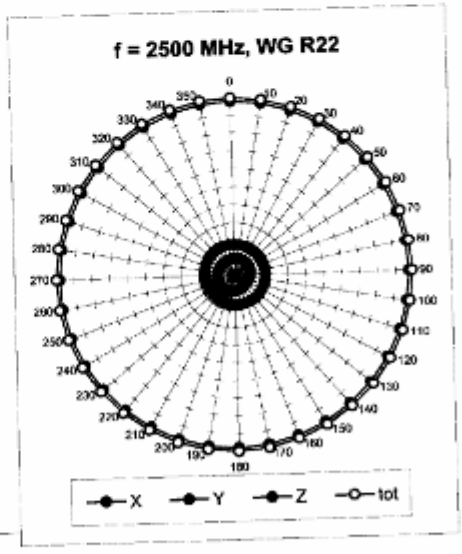
Receiving Pattern (ϕ), ϑ = 0°





Receiving Pattern (ϕ), ϑ = 90°

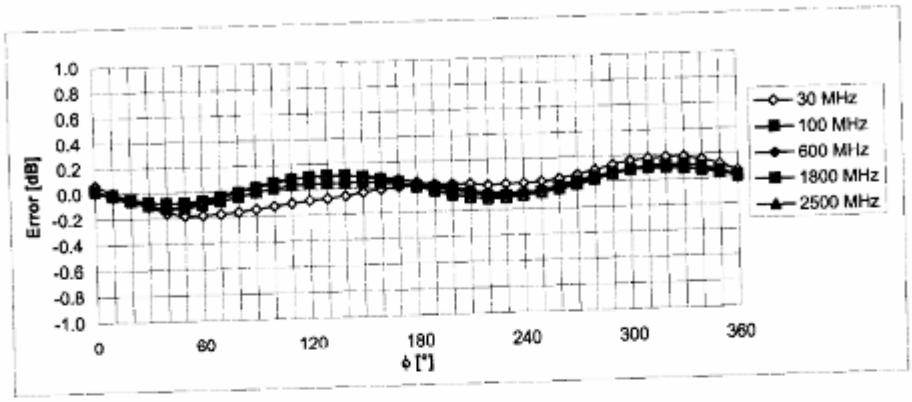




ER3DV4R SN:2240

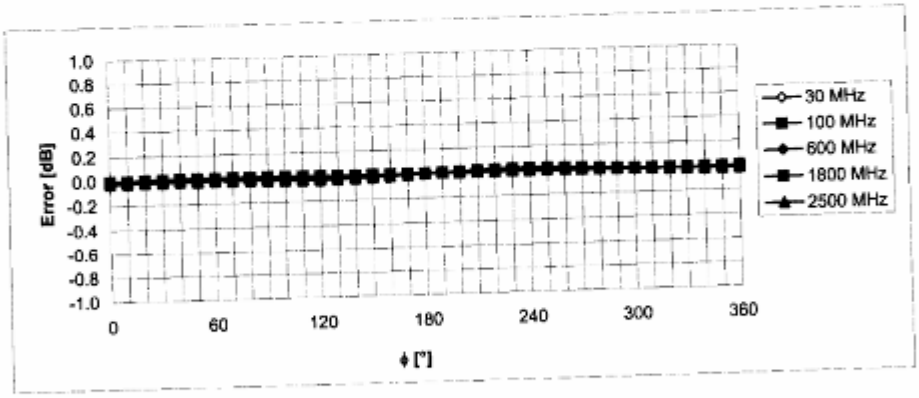
January 24, 2006

Receiving Pattern (ϕ), ϑ = 0°



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

Receiving Pattern (ϕ), ϑ = 90°

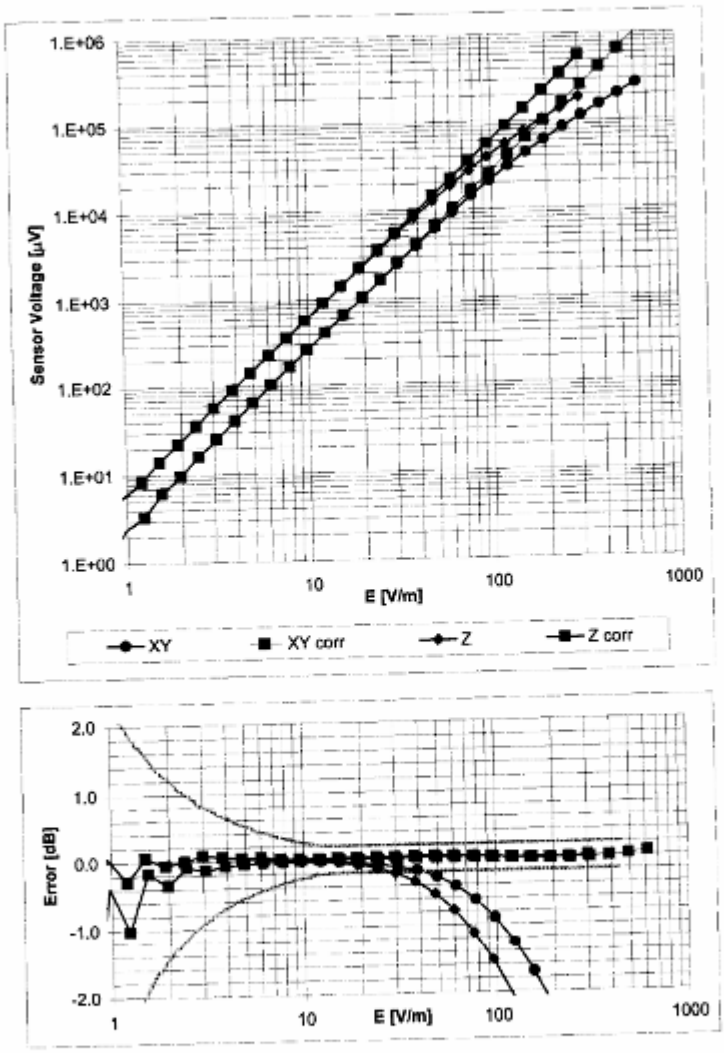


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

ER3DV4R SN:2240 **January 24, 2006**

Dynamic Range f(E-field)

(Waveguide R22, f = 1800 MHz)



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

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Accreditation No.: SCS 108

Client **Nokia TX** Certificate No: **H3-6058_Jan06**

CALIBRATION CERTIFICATE

Object	H3DV6 - SN:6058
Calibration procedure(s)	QA CAL-03.v4 Calibration procedure for H-field probes optimized for close near field evaluations in air
Calibration date:	January 24, 2006
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41495277	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41498087	3-May-05 (METAS, No. 251-00466)	May-06
Reference 3 dB Attenuator	SN: S5054 (3c)	11-Aug-05 (METAS, No. 251-00499)	Aug-06
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-05 (METAS, No. 251-00467)	May-06
Reference 30 dB Attenuator	SN: S5129 (30b)	11-Aug-05 (METAS, No. 251-00500)	Aug-06
Reference Probe H3DV6	SN: 6182	3-Oct-05 (SPEAG, No. H3-6182_Oct05)	Oct-06
DAE4	SN: 654	27-Oct-05 (SPEAG, No. DAE4-654_Oct05)	Oct-06

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

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

Issued: January 24, 2006

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe H3DV6

SN:6058

Manufactured:	October 15, 1999
Last calibrated:	January 20, 2005
Recalibrated:	January 24, 2006

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

H3DV6 SN:6058 January 24, 2006

DASY - Parameters of Probe: H3DV6 SN:6058

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

	a0	a1	a2
X	**2.703E-03**	**-4.915E-5**	**8.957E-6** ± 5.1 % (k=2)
Y	**2.563E-03**	**-3.821E-5**	**1.276E-5** ± 5.1 % (k=2)
Z	**2.898E-03**	**-2.477E-4**	**2.027E-5** ± 5.1 % (k=2)

Diode Compression[1]

DCP X	**85** mV
DCP Y	**85** 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 **262** °

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%.

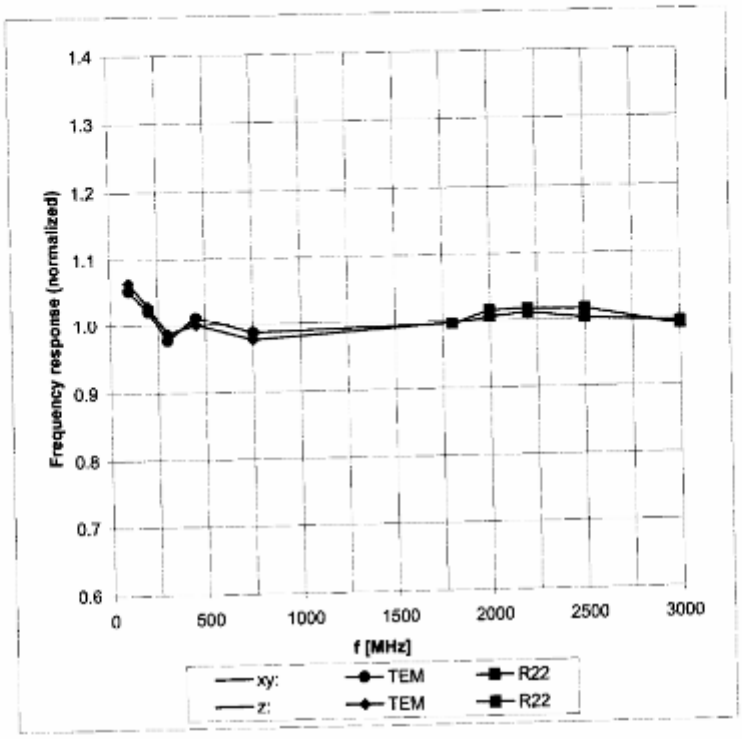
[1] numerical linearization parameter: uncertainty not required

H3DV6 SN:6058

January 24, 2006

Frequency Response of H-Field

(TEM-Cell:ifi110, Waveguide R22)

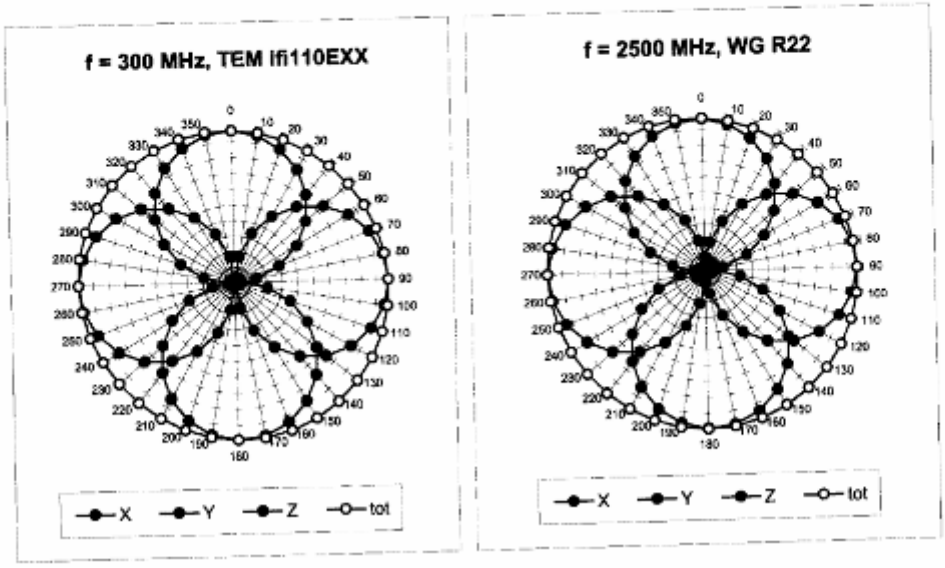


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

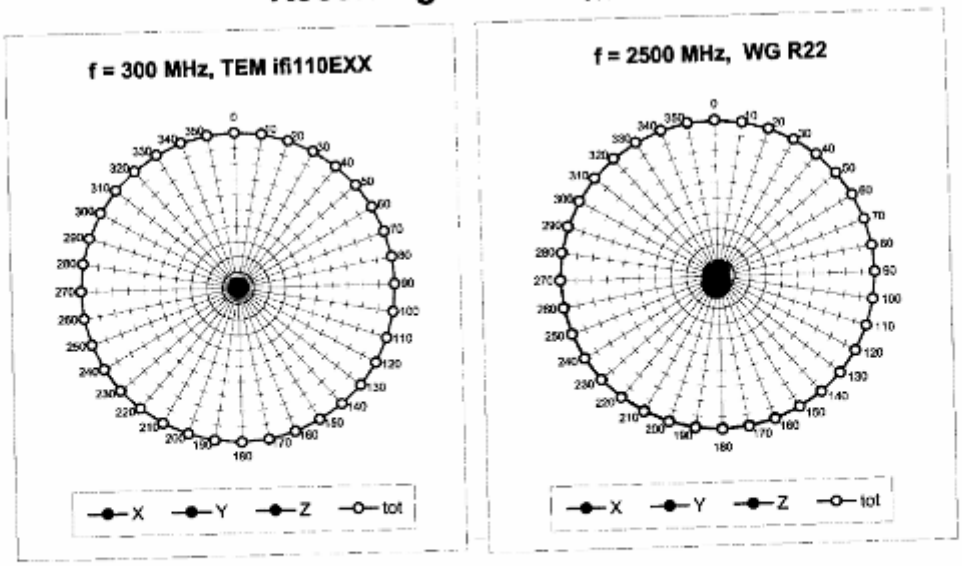
H3DV6 SN:6058

January 24, 2006

Receiving Pattern (ϕ), ϑ = 90°

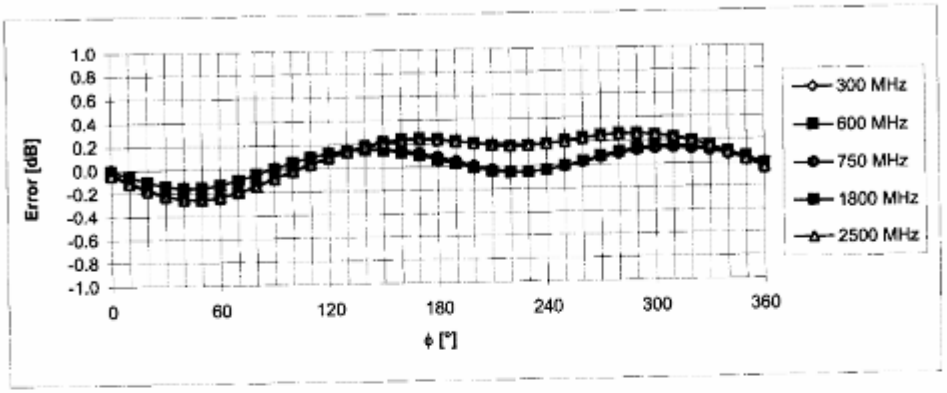


Receiving Pattern (ϕ), ϑ = 0°



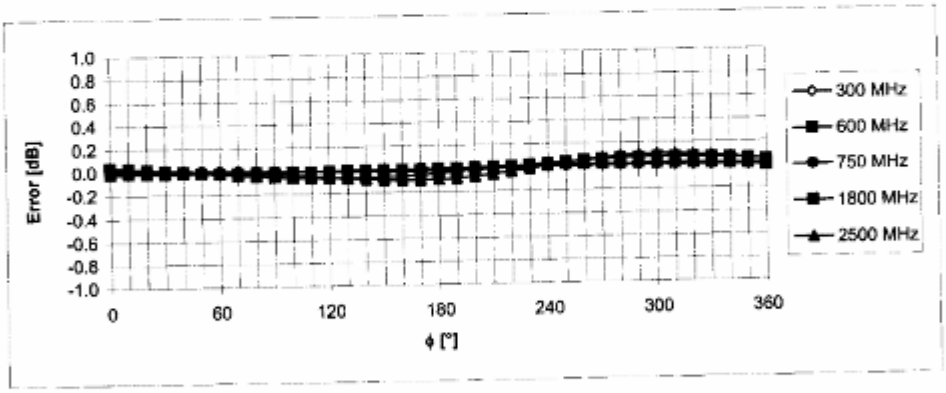
H3DV6 SN:6058 **January 24, 2006**

Receiving Pattern (ϕ), ϑ = 90°



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

Receiving Pattern (ϕ), ϑ = 0°



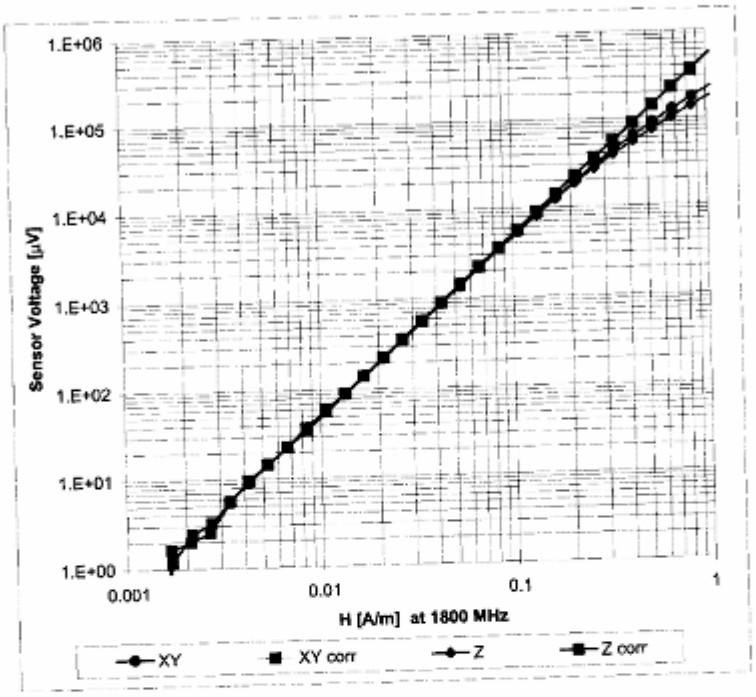
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

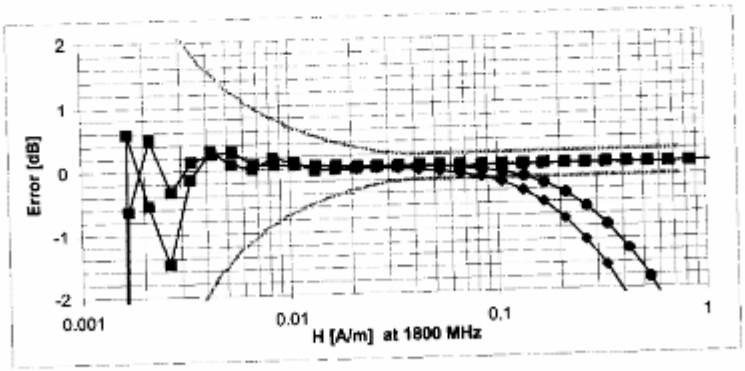
H3DV6 SN:6058

January 24, 2006

Dynamic Range f(H-field)

(Waveguide R22, f = 1800 MHz)





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