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Regulatory Compliance Group
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Gyeonggi-do, Korea 443-742

TEST REPORT ON HAC

Model Tested:	**SPH-M510**
FCC ID (Requested):	**A3LSPHM510**
Job No:	**AD-076**
Report No:	**AD-076-M1**
Date issued:	**Dec.07, 2006**
Result Summary:	**M3 (RF EMISSION Category)**

- Abstract -

This document reports on HAC Tests carried out in accordance with ANSI C63.19(2006), FCC Rule Part(s) FCC 47 CFR §20.19, §6.3, §7.3

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1. GENERAL INFORMATION

Test Sample :	Dual-Band CDMA Phone with Bluetooth
Model Number :	SPH-M510
Serial Number :	Identical prototype (S/N : #FD-200-G)
Manufacturer :	SAMSUNG ELECTRONICS Co., Ltd.
Contact :	YM Kwon
Phone :	+82-54-479-5931
Fax :	+82-54-479-5866
Test Standard :	ANSI C 63.19 (2006), FCC 47 CFR § 20.19, §6.3, §7.3
FCC Classification :	Licensed Portable Transmitter Held to Ear (PCE)
Test Dates :	Nov.21, 2007
Tested for :	FCC/TCB Certification

2. DESCRIPTION OF DEVICE

Tx Freq. Range :	824.70 ~ 848.31 MHz (CDMA)
	1851.25 ~ 1908.75 MHz (PCS)
Rx Freq. Range :	869.70 ~ 893.31 MHz (CDMA)
	1931.25 ~ 1988.75 MHz (PCS)
Antenna Configuration :	Intenna
Antenna Dimensions :	52.2 mm

3. DESCRIPTION OF TEST EQUIPMENT

3.1 HAC Measurement Setup

Robotic System

Measurements are performed using the DASY4 automated dosimetric assessment system. Which is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Stäubli), robot controller, measurement server, Samsung computer, near-field probe, probe alignment sensor, and the SAM twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 3.1).

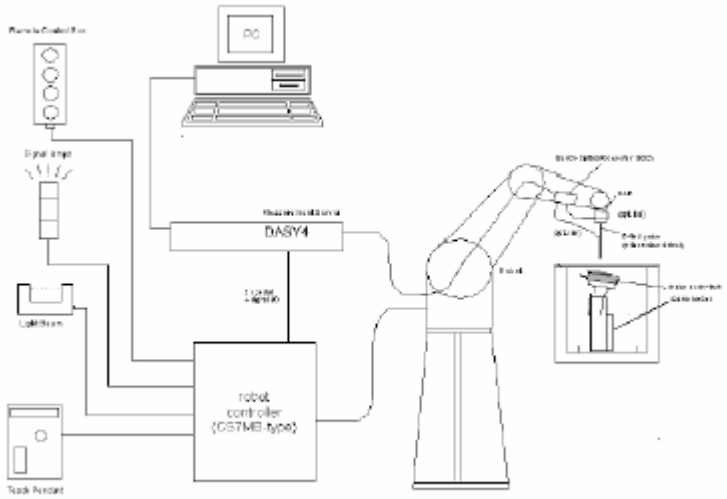


Figure 3.1 HAC Measurement System Setup

System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control is used to drive the robot motors. The PC consists of the Samsung computer with Windows XP system and HAC Measurement Software DASY4, LCD monitor, mouse and keyboard. The Stäubli 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 measurement server

System Electronics

The DAE4(or DAE3) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information 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.

3.2 Probe Description

ER3DV6 E-Field Probe Description

Construction: One dipole parallel, two dipoles normal to probe axis
Built-in shielding against static charges

Figure 3.2 E-field Probe

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 2V/m to 1000V/m
(M3 or better device readings fall well below diode compression point)

Linearity : ±0.2dB

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

H3DV6 H-Field Probe Description

Construction: Three concentric loop sensors with 3.8 mm loop diameters Resistively loaded detector diodes for linear response Built-in shielding against static charges

Frequency: 200 MHz to 3 GHz (absolute accuracy ± 6.0%, k=2); Output linearized

Directivity: ± 0.25 dB (spherical isotropy error)

Dynamic Range: 10mA/m to 2A/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)

Figure 3.3 H-field Probe

3.3 Test Arch Phantom

Enables easy and well defined positioning of the phone and calibration dipoles as well as simple teaching of the robot (See Figure 3.4)

Dimensions: 370 x 370 x 370 mm

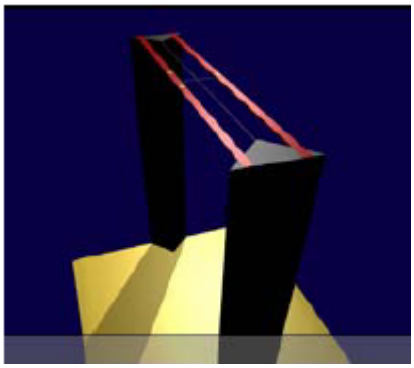


Figure 3.4 Test Arch Phantom

3.4 Validation Dipole

The reference dipole should have a return loss better than –20 dB (measured in the setup) at the resonant frequency to reduce the uncertainty in the power measurement.

Application	- Free space antenna - Hearing Aid susceptibility measurements according to ANSI C 63.19 - Validation of Hearing Aid RF setup for wireless device emission measurement according to ANSI C63.19
Frequency	835 MHz, 1880 MHz, 2450 MHz
Return Loss	< -20 dB at specified validation position
Dimensions	835 MHz : 166 x 330 mm 1880MHz : 80.8 x 330 mm 2450MHz : 59.9 x 330 mm

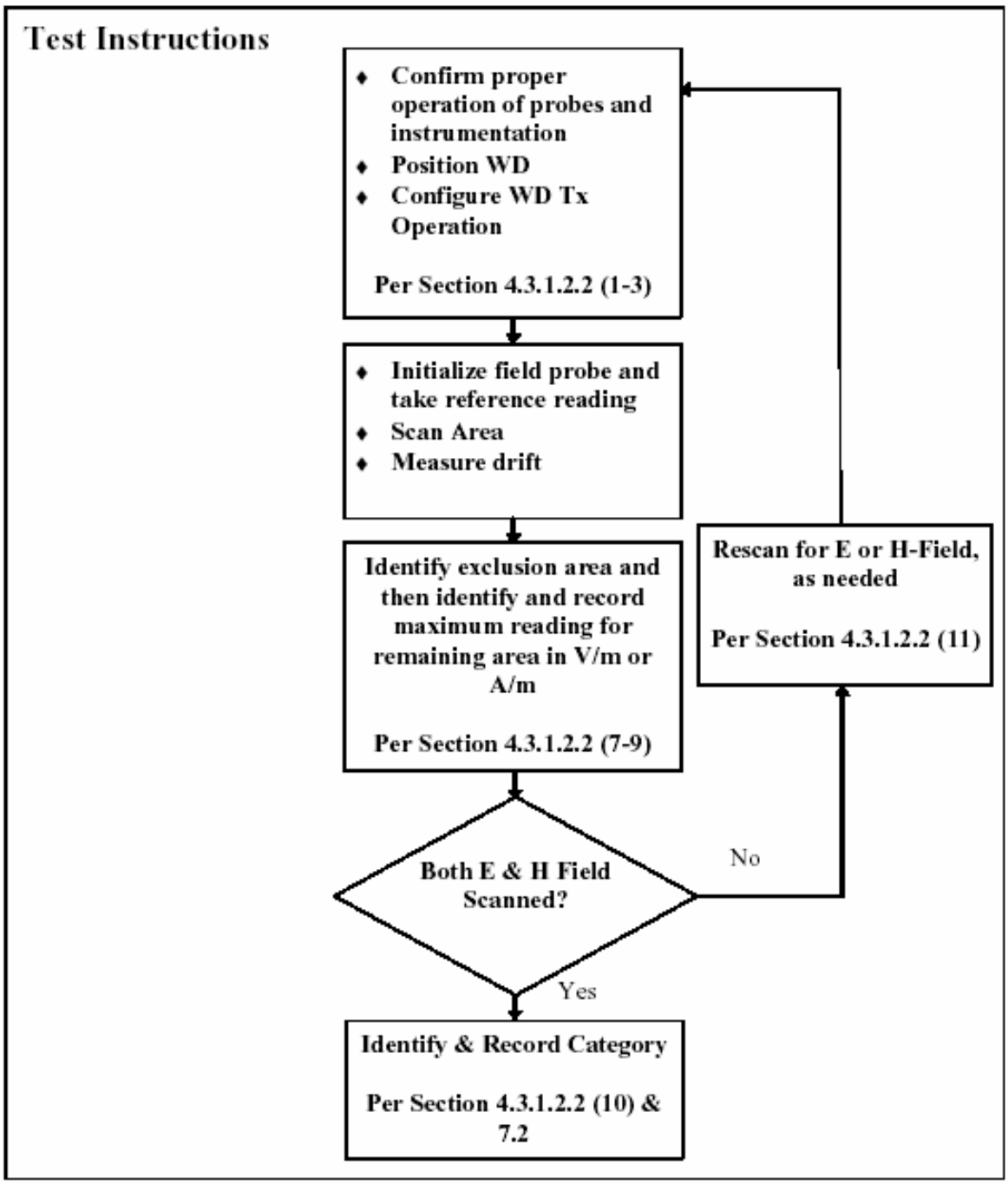
3.5 Equipment Calibration

Table 3.2 Test Equipment Calibration

Type	Calibration Due Date	Serial No.
SPEAG DAE3 V1	Jan.27, 2007	468
E-field Free space Probe	Sep.20, 2007	2342
H-field Free space Probe	Sep.20, 2007	6159
CD835V3 Free space 835MHz Dipole	Apr.27, 2007	1021
CD1880V3 Free space 1880MHz Dipole	Apr.05, 2007	1016
Stäubli Robot RX90BL	Not Required	F05/51G6A1/A/01
HAC Phantom	Not Required	1018
Spectrum Analyzer	Jan.06, 2007	MY45304704
E4438C Signal Generator	Apr.06, 2007	MY45092224
BBS3Q7ECK Power Amp	Jan.26, 2007	1023
NRVD Power Meter	Feb.16, 2007	836416/020
N1912A Power Meter	Mar.06, 2007	MY45100306
NRV-Z53 Power Sensor	Feb.16, 2007	835324/001
NRV-Z55 Power Sensor	Feb.16, 2007	834558/012
DASY4 S/W (ver 4.7)	Not Required	-
Directional Coupler	May.12, 2007	18843
Wireless Communication System Set	Dec.01, 2006	GB43460148

NOTE:
The E-field and H-field probe was calibrated by SPEAG,

4. HAC MEASUREMENT PROCEDURE



The evaluation was performed using the following procedure.

1. Confirm proper operation of the field probe, probe measurement system, and other instrumentation.

2. WD is positioned in its intended test position, acoustic output point of the device perpendicular to the field probe.

3. 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.

4. The center sub-grid was centered over the center of the acoustic output (also audio band magnetic output, if applicable). The WD 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 HAC Phantom.

6. The measurement system measured the field strength at the reference location.

7. Measurements at 2mm increments in the 5 x 5 cm region were performed and recorded.

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.

5. DESCRIPTION OF TEST POSITION

5.1 Measurement reference and plane

1. The grid is 5 cm by 5 cm area that is divided into 9 evenly sized blocks or sub-grids.

2. The grid is centered on the audio frequency output transducer of the WD (speaker or T- coil).

3. 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 WD handset, which, in normal handset use, rest against the ear.

4. The measurement plane is parallel to, and 1.0 cm in front of, the reference plane.

Figure 5.1 Wireless Device and Measurement Plane

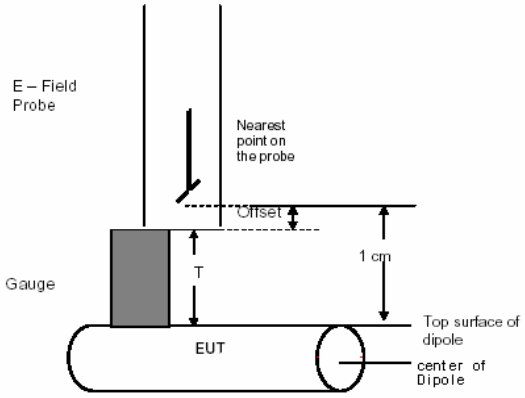


Figure 5.2 Gauge block with E-field probe

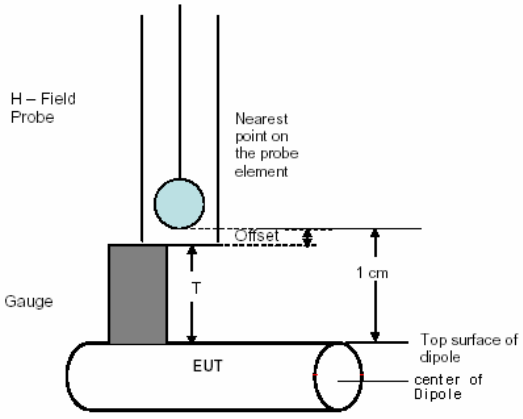


Figure 5.3 Gauge block with H-field probe

6. MEASUREMENT UNCERTAINTY

Source of Uncertainty	Value	Probability distribution	Divisor	c_i E	c_i H	Standard uncertainty		v_i or v_{eff}	
						E	H	E	H
Measurement System									
Probe Calibration	10.20	normal	2.000	0.99	1	5.05	5.10	∞	∞
Axial Isotropy	4.70	rectangular	1.732	1	1	2.71	2.71	∞	∞
Sensor Displacement	16.50	rectangular	1.732	1	0.145	9.53	1.38	∞	∞
Boundary Effects	2.40	rectangular	1.732	1	1	1.39	1.39	∞	∞
Linearity	4.70	rectangular	1.732	1	1	2.71	2.71	∞	∞
Scaling to Peak Envelop Power	2.00	rectangular	1.732	1	1	1.15	1.15	∞	∞
System Detection Limit	1.00	rectangular	1.732	1	1	0.58	0.58	∞	∞
Readout Electronics	0.30	normal	1.000	1	1	0.30	0.30	∞	∞
Response Time	0.80	rectangular	1.732	1	1	0.46	0.46	∞	∞
Integration time	2.60	rectangular	1.732	1	1	1.50	1.50	∞	∞
RF Ambient condition	3.00	rectangular	1.732	1	1	1.73	1.73	∞	∞
RF Reflections	1.74	normal	1.000	1	0.68	1.74	1.19	∞	∞
Probe Positioner	1.20	rectangular	1.732	1	0.67	0.69	0.46	∞	∞
Probe Positioning	4.70	rectangular	1.732	1	0.67	2.71	1.82	∞	∞
Extrap. And Interpolation	1.00	rectangular	1.732	1	1	0.58	0.58	∞	∞
Test Sample Related									
Device Positioning	1.53	normal	1.000	1	0.94	1.53	1.44	23	23
Device Holder and Phantom	2.40	rectangular	1.732	1	1	1.39	1.39	∞	∞
Power Drift	5.00	rectangular	1.732	1	1	2.89	2.89	∞	∞
Phantom and Setup Related									
Phantom Thickness	2.40	rectangular	1.732	1	0.67	1.39	0.93	∞	∞
Combined Standard Uncertainty		normal	-	-	-	**12.88**	**8.38**	**147117**	**26396**
Expanded Uncertainty [95% confidence]						**25.76**	**16.76**		
Expanded Uncertainty [95% confidence] on Field						**12.88**	**8.38**		

7. SYSTEM VERIFICATION

7.1 Test System Validation

Prior to assessment, the system is verified to the ±10% of the specification at 835MHz, 1880MHz, by using the system validation kit(s). (see Appendix E, Graphic Plot Attached)

Table 7.2 System Validation Results

Frequency	Targeted E-field (V/m)	Measured E-field (V/m)	Deviation (%)	Targeted H-field (A/m)	Measured H-field (A/m)	Deviation (%)	Date
835 MHz	167.1	**165.6**	**-0.90**	0.439	**0.445**	**1.37**	Nov.15, 2006
1880 MHz	138.6	**144.6**	**4.33**	0.457	**0.434**	**-5.03**	Nov.15, 2006

*Validation was measured with input power 100 mW.

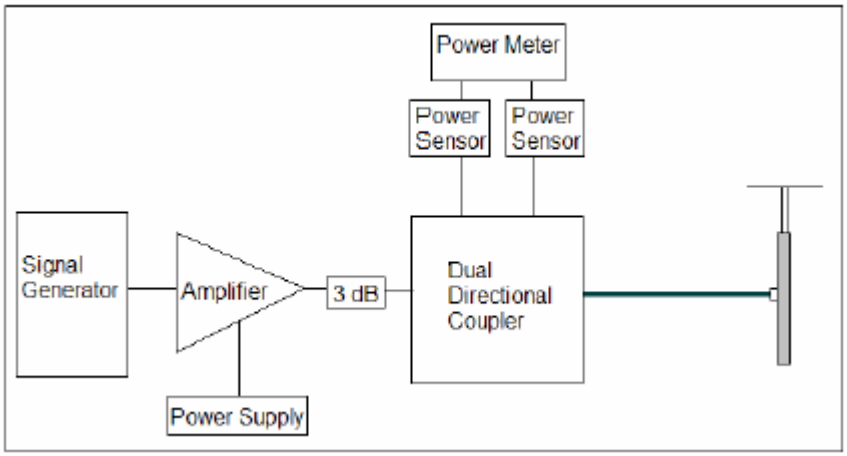


Figure 7.1 Dipole Validation Test Setup

Validations of the DASY4 test system were performed using the measurement equipment listed in Section 3.2. All validations occur in free space using the DASY4 test arch. Note that the 10mm probe to dipole separation is measured from the top edge of the dipole to the calibration reference point of the probe. SPEAG uses the center point of the probe sensor(s) as the reference point when establishing targets for their dipoles. Therefore, because SPEAG's dipoles and targets are used, it is appropriate to measure the 10mm separation distance to the center of the sensors as they do. This reference point was used for validation only. Validations were performed at 835 MHz and/or 1880 MHz. These frequencies are within each operating band and are within 2MHz of the mid-band frequency of the test device. The obtained results from the validations are displayed in the table 7.2.

8. MODULATION FACTOR

After every probe calibration, the response of the probe to each applicable modulated signal (CDMA, GSM, etc) must be assessed at both 835 MHz and 1880 MHz. 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. For each PMF assessment, a Signal Generator was used to replace the original CW signal with the desired modulated signal. The PMF results are shown in Tables 5.

RF Field Probe Modulation Response was measured with the field probe and associated measurement equipment. The proposed setup corresponds to the procedure as required in the Standard.

1. Install a validation dipole for the appropriate frequency band under the Test Arch Phantom Move the probe to the field reference point. Do not move the probe between the corresponding CW and modulated measurements.
2. Install the field probe in the setup.
3. The signal to the dipole must be monitored to record peak amplitude. Set a CW signal to the same level (refer to Appendix B)
4. Set the procedure properties (frequency, modulation frequency and crest factor) according to the measured signal. Define a multimeter job for the field reading.
5. Define a second procedure for the evaluation of the CW signal (frequency set as above, modulation frequency = 0, crest factor = 1) and a multimeter job.

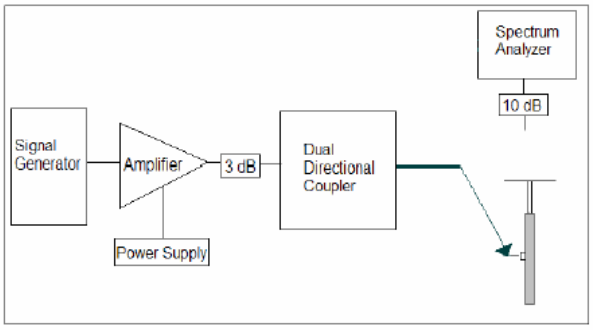


Figure 8.1 Setup to Dipole

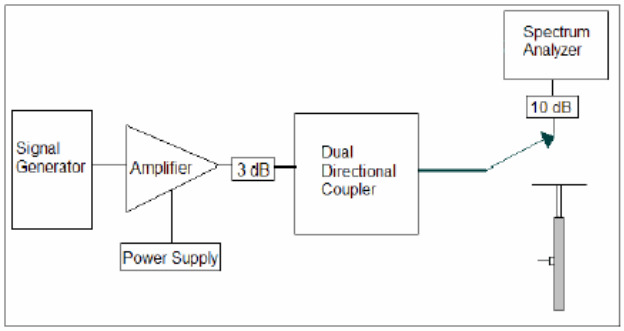


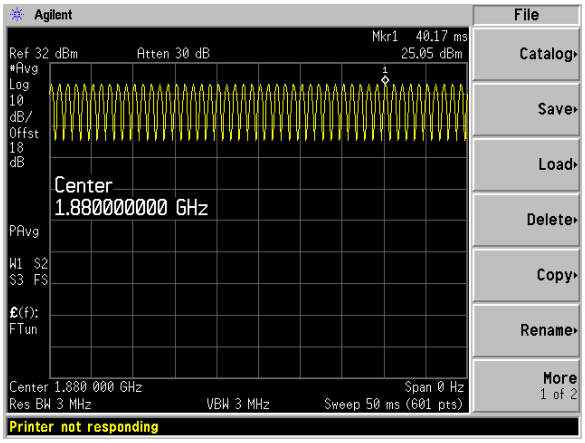
Figure 8.2 Setup to Peak Power using Spectrum Analyzer

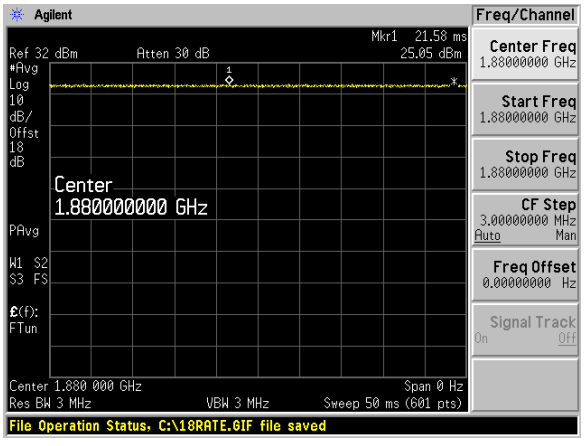
8.1 Modulation Factors

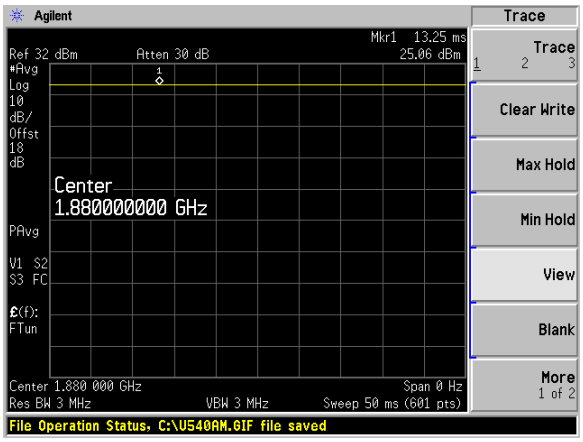
Frequency	Protocol	E-field (V/m)	H-field (A/m)	E-Field PMF	H-Field PMF
835MHz	AM	36.35	0.219	**1.59**	**1.54**
	CDMA	57.7	0.318	**1.00**	**1.06**
	CW	57.8	0.338	-	-
1880 MHz	AM	32.48	0.105	**1.55**	**1.54**
	CDMA	48.3	0.161	**1.05**	**1.01**
	CW	50.5	0.162	-	-
	CDMA/SO3	29.1	-	**2.77**	-
	CW	80.75	-	-	-

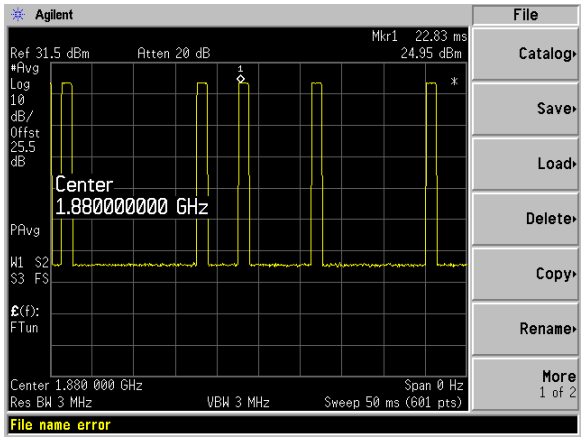
Table 8.1 Modulation Factors

8.2 CW and Modulated Signal Zero-span plots:









9. FCC 3G MEASUREMENTS – MAY/JUNE 2006

Sample pre-testing of the various modes were performed at the worst case probe location as part of subset testing justification. See below for measured conducted power for applicable device modes.

9.1 Handset Capabilities*

* See Device Capabilities attachment for applicable device modes and powers

9.2 Worst-Case Probe Location Measurements

Below are RC/SO mode investigation results of the device at the worst-case(maximum) field point location

Mode	Channel	Back light	RC/SO	Battery	Conducted Power at BS(dBm)	Time Avg. Field [V/m]	Peak Field [V/m]	Peak Field [dBV/m]	Category	FCC limit [dBV/m]	FCC Margin [dB]
E-field Emissions											
PCS	**25**	**off**	**RC3/SO55**	**Standard**	**25.02**	**52.3**	**54.92**	**34.8**	**M4**	**41**	**-6.21**
PCS	25	on	RC3/SO55	Standard	24.98	50.8	53.34	34.5	M4	41	-6.46
PCS	25	off	RC1/SO2	Standard	25.01	52.2	54.81	34.8	M4	41	-6.22
PCS	25	off	RC3/SO2	Standard	24.98	50.7	53.23	34.5	M4	41	-6.48
PCS	25	off	RC1/SO55	Standard	25.01	52.2	54.81	34.8	M4	41	-6.22
PCS	25	off	RC2/SO9	Standard	25.04	52	54.6	34.7	M4	41	-6.26
PCS	25	off	RC1/SO3	Standard	25.31	19.9	20.90	26.4	M4	41	-14.60
PCS	25	off	RC3/SO3	Standard	25.1	51	53.55	34.6	M4	41	-6.42
PCS	25	off	RC2/SO17	Standard	24.99	19.7	20.69	26.3	M4	41	-14.69

Table 9-1 Handset 3G mode variation on RF Emission

10. Test Results

10.1 Measurement Results (E-field)

E-FIELD EMISSIONS:

Mode	Channel	RC/SO	Back light	Battery	Conducted Power [dBm]	Time Avg. Field [A/m]	Peak Field [V/m]	Peak Field [dBV/m]	Category	FCC limit [dBV/m]	FCC Margin [dB]	Excl Blocks
CDMA	1013	RC3/SO55	Off	Standard	25.13	54.7	54.7	34.8	M4	51	-16.24	none
CDMA	384	RC3/SO55	Off	Standard	25.15	57.0	57	35.1	M4	51	-15.88	none
CDMA	777	RC3/SO55	Off	Standard	25.22	61.5	61.5	35.8	M4	51	-15.22	none
PCS	25	RC3/SO55	Off	Standard	25.21	50.9	53.4	34.6	M4	41	-6.45	none
PCS	600	RC3/SO55	Off	Standard	25.01	48.5	50.9	34.1	M4	41	-6.87	none
PCS	1175	RC3/SO55	on	Standard	24.98	52.0	54.6	34.7	M4	41	-6.26	none
PCS	1175	RC3/SO55	Off	Standard	24.98	49.1	51.6	34.3	M4	41	-6.75	none

NOTES:

1. The test data reported are the worst-case HAC value with the test position set in a typical configuration. Test procedures used are according to ANSI C 63.19 (2006).

2. All modes of operation were investigated, and the worst-case results are reported.
3. Battery is fully charged for all readings.
4. *Power Measured ☒ Conducted
5. Battery Option ☒ Standard ☐ Extended ☐ Slim
6. Bluetooth deactivated (According to customer's request)

Note: Worst-case measurement evaluated for worst-case 1/8 rate gating condition in RC1/SO3; Mute=Yes

10.2 Measurement Results(H-field)

H-FIELD EMISSIONS:

Mode	Channel	RC/SO	Back light	Battery	Conducted Power [dBm]	Time Avg. Field [A/m]	Peak Field [A/m]	Peak Field [dBA/m]	Category	FCC limit [dBA/m]	FCC Margin [dB]	Excl Blocks
CDMA	1013	RC3/SO55	Off	Standard	25.13	0.109	0.116	-18.71	M4	0.6	-19.31	none
CDMA	384	RC3/SO55	Off	Standard	25.15	0.136	0.144	-16.83	M4	0.6	-17.43	none
CDMA	777	RC3/SO55	Off	Standard	25.22	0.117	0.124	-18.13	M4	0.6	-18.73	none
PCS	25	RC3/SO55	Off	Standard	25.21	0.218	0.22	-13.15	M3	-9.4	-3.75	none
PCS	600	RC3/SO55	Off	Standard	25.01	0.167	0.169	-15.44	M4	-9.4	-6.04	none
PCS	1175	RC3/SO55	Off	Standard	24.98	0.178	0.18	-14.89	M4	-9.4	-5.49	none

NOTES:

1. The test data reported are the worst-case HAC value with the test position set in a typical configuration. Test procedures used are according to ANSI C 63.19 (2006).

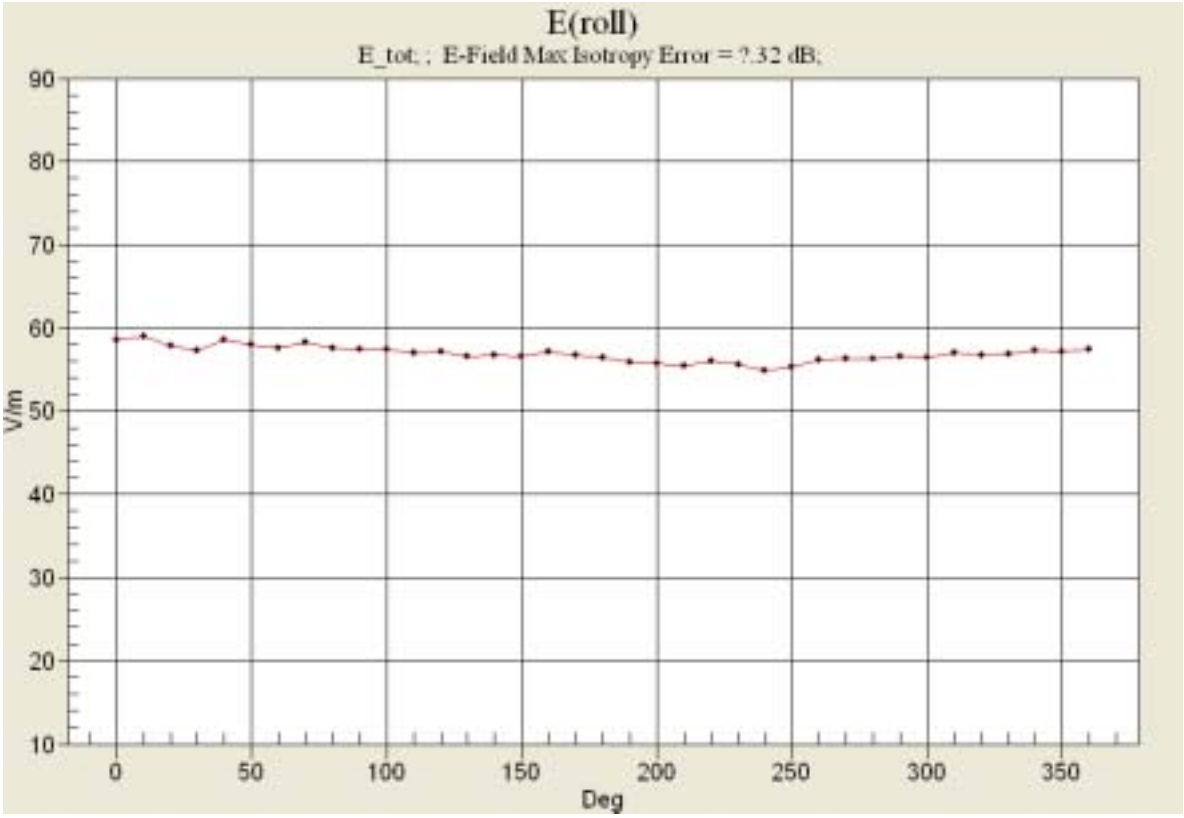
2. All modes of operation were investigated, and the worst-case results are reported.
3. Battery is fully charged for all readings.
4. *Power Measured ☒ Conducted
5. Battery Option ☒ Standard ☐ Extended ☐ Slim
6. Bluetooth deactivated (According to customer's request)

10.3 Worst-case Configuration Evaluation

CDMA E-field Emission

Mode	Channel	RC/SO	Back light	Battery	Conducted Power [dBm]	Time Avg. Field [V/m]	Peak Field [V/m]	Peak Field [dBV/m]	Category	FCC limit [dBV/m]	FCC Margin [dB]
CDMA	777	RC3/SO55	Off	Standard	25.22	56.9	56.9	35.1	M4	51	-15.9

Peak Reading 360 degree Probe Rotation at Azimuth axis



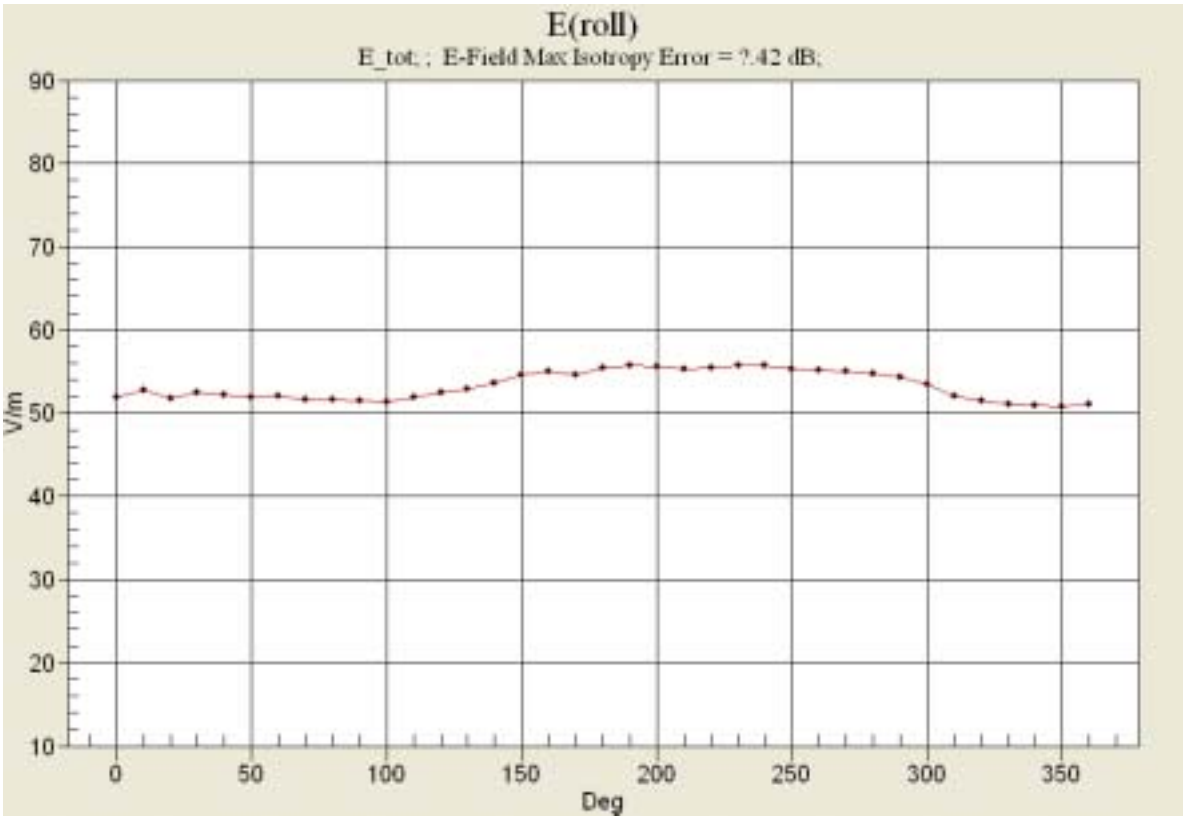
Worst-Case Probe Rotation about Azimuth axis

Note: Location of probe rotation is shown in APPENDIX E

PCS E-field Emission

Mode	Channel	RC/SO	Back light	Battery	Conducted Power [dBm]	Time Avg. Field [V/m]	Peak Field [V/m]	Peak Field [dBV/m]	Category	FCC limit [dBV/m]	FCC Margin [dB]
PCS	1175	RC3/SO55	Off	Standard	24.98	50.8	53.3	34.5	M4	41	-6.5

Peak Reading 360 degree Probe Rotation at Azimuth axis



Worst-Case Probe Rotation about Azimuth axis

Note: Location of probe rotation is shown in APPENDIX E

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APPENDIX A

Probe Modulation Factor

Measurement procedure

1. Modulated signal measurement: Connect the modulated signal with the correct frequency via the cable to the dipole.
2. Run the multimeter in the procedure with the corresponding modulation setting in continuous mode.
3. Adjust the signal amplitude to acheive the same field level display in the multimeter as during the WD field scan. Read the multimeter display and note it together with the probe ID, modulation type and frequency.
4. Read the peak envelope on the monitor in order to adjust the CW signal later to the same level.
5. Switch the signal source off and verify that the ambient and instrumentation noise level is at least 10dB lower.
6. CW measurement: Change the signal to CW at the same center frequency, without touching or moving the dipole or probe in the setup.
7. Adjust the CW signal amplitude to the same peak level on the monitor.
8. Run the multimeter in the CW procedure in continuous mode.
9. Read the multimeter display and note it together with the probe ID, modulation type and frequency.
10. Calculate the Probe Modulation Factor as the ratio between the CW multimeter field reading and the reading for the applicable modulation.
11. Perform the above setup and procedure for E-field and H-field probes.

Spectrum Analyzer setting.

1. Frequency Setting

ex) 835 MHz, 1880MHz, 2450 MHz

2. RBW/VBW/SPAN/Detector Setting.

	CW	GSM	CDMA	WCDMA	AM 80%
RBW	Same setting with modulated signal respectively.	**1 MHz**	**3 MHz**	**5 MHz**	**1 MHz**
VBW		**1 MHz**	**3 MHz**	**5 MHz**	**1 MHz**
SPAN		**0 MHz**	**0 MHz**	**0 MHz**	**0 MHz**
DETECTOR		**Peak**	**Average**	**Average**	**Peak**

3. Trigger: Video or IF trigger, adjusted to give a stable display of the transmission

4. Sweep rate: Sufficiently rapid to permit the transmit pulse to be resolved accurately.

APPENDIX B

ANSI C63.19 (2006)- Telephone near-field categories.

Category	Telephone RF Parameters <960MHz				
Near Field	**AWF**	**E-Field Emissions**		**H-Field Emissions**	
Category M1/T1	0	631.0 to 1122.0	**V/m**	1.91 to 3.39	**A/m**
	-5	473.2 to 841.4	**V/m**	1.43 to 2.54	**A/m**
Category M2/T2	0	354.8 to 631.0	**V/m**	1.07 to 1.91	**A/m**
	-5	266.1 to 473.2	**V/m**	0.80 to 1.43	**A/m**
Category M3/T3	0	199.5 to 354.8	**V/m**	0.60 to 1.07	**A/m**
	-5	149.6 to 266.1	**V/m**	0.45 to 0.80	**A/m**
Category M4/T4	0	< 199.5	**V/m**	< 0.60	**A/m**
	-5	< 149.6	**V/m**	< 0.45	**A/m**
Category	**Telephone RF Parameters <960MHz**				
Near Field	**AWF**	**E-Field Emissions**		**H-Field Emissions**	
Category M1/T1	0	199.5 to 354.8	**V/m**	0.60 to 1.07	**A/m**
	-5	149.6 to 266.1	**V/m**	0.45 to 0.80	**A/m**
Category M2/T2	0	112.2 to 199.5	**V/m**	0.34 to 0.60	**A/m**
	-5	84.1 to 149.6	**V/m**	0.25 to 0.45	**A/m**
Category M3/T3	0	63.1 to 112.2	**V/m**	0.19 to 0.34	**A/m**
	-5	47.3 to 84.1	**V/m**	0.14 to 0.25	**A/m**
Category M4/T4	0	<63.1	**V/m**	<0.19	**A/m**
	-5	<47.3	**V/m**	<0.14	**A/m**

Table B.1 Telephone near-field categories in linear units.

Category	Telephone RF Parameters <960MHz				
Near Field	**AWF**	**E-Field Emissions**		**H-Field Emissions**	
Category M1/T1	0	56 to 61	**dB (V/m)**	+5.6 to +10.6	**dB (A/m)**
	-5	53.5 to 58.5	**dB (V/m)**	+3.1 to +8.1	**dB (A/m)**
Category M2/T2	0	51 to 56	**dB (V/m)**	+0.6 to +5.6	**dB (A/m)**
	-5	48.5 to 53.5	**dB (V/m)**	-1.9 to +3.1	**dB (A/m)**
Category M3/T3	0	46 to 51	**dB (V/m)**	-4.4 to +0.6	**dB (A/m)**
	-5	43.5 to 48.5	**dB (V/m)**	-6.9 to -1.9	**dB (A/m)**
Category M4/T4	0	<46	**dB (V/m)**	< -4.4	**dB (A/m)**
	-5	< 43.5	**dB (V/m)**	< -6.9	**dB (A/m)**
Category	**Telephone RF Parameters <960MHz**				
Near Field	**AWF**	**E-Field Emissions**		**H-Field Emissions**	
Category M1/T1	0	46 to 51	**dB (V/m)**	-4.4 to 0.6	**dB (A/m)**
	-5	43.5 to 48.5	**dB (V/m)**	-6.9 to -1.9	**dB (A/m)**
Category M2/T2	0	41 to 46	**dB (V/m)**	-9.4 to -4.4	**dB (A/m)**
	-5	38.5 to 43.5	**dB (V/m)**	-11.9 to -6.9	**dB (A/m)**
Category M3/T3	0	36 to 41	**dB (V/m)**	-14.4 to -9.4	**dB (A/m)**
	-5	33.5 to 38.5	**dB (V/m)**	-16.9 to -11.9	**dB (A/m)**
Category M4/T4	0	<36	**dB (V/m)**	<-14.4	**dB (A/m)**
	-5	<33.5	**dB (V/m)**	<-16.9	**dB (A/m)**

Table B.2 Telephone near-field categories in logarithmic units.

APPENDIX D

The Validation Measurements

DUT: HAC-Dipole 835 MHz; Serial: SN:1021
Program Name: HAC E Dipole
Procedure Name: E Scan 10mm above CD 835 MHz

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

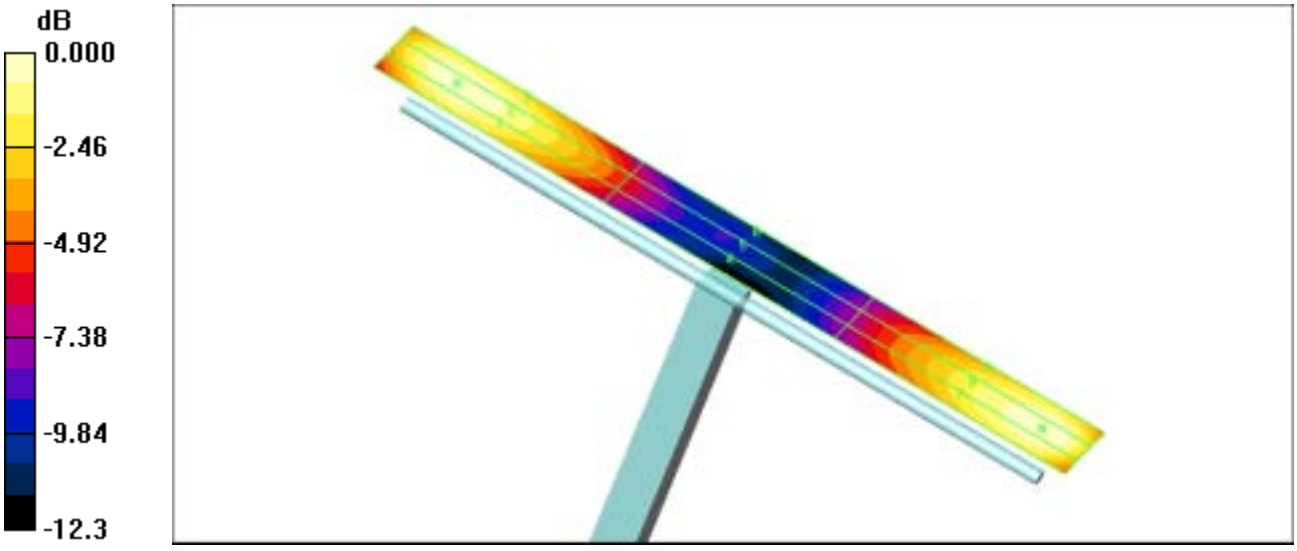
DASY4 Configuration:
- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

E Scan 10mm above CD 835 MHz/Hearing Aid Compatibility Test (41x361x1):

Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 165.7 V/m
Probe Modulation Factor = 1.00
Reference Value = 105.2 V/m; Power Drift = -0.087 dB

Peak E-field in V/m

Grid 1 **158.4**	Grid 2 **164.7**	Grid 3 **161.7**
Grid 4 **83.8**	Grid 5 **86.7**	Grid 6 **84.8**
Grid 7 **161.7**	Grid 8 **165.7**	Grid 9 **160.3**



0 dB = 165.7V/m

DUT: HAC Dipole 1880 MHz; Serial: SN:1016
Program Name: HAC E Dipole
Procedure Name: E Scan 10mm above CD 1880 MHz

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

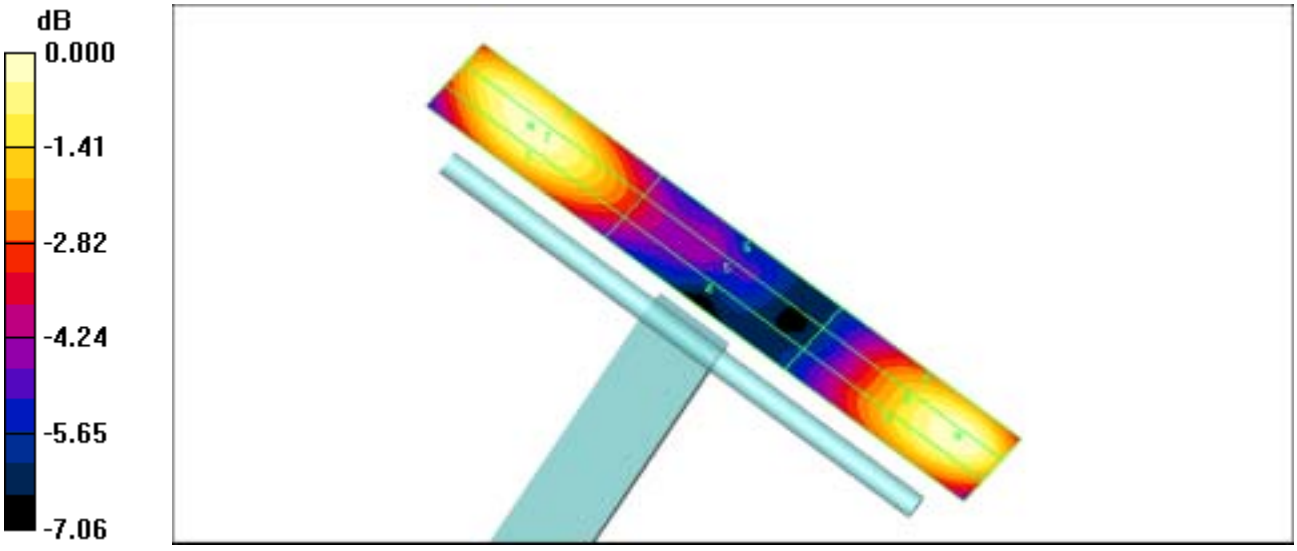
DASY4 Configuration:
- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

E Scan 10mm above CD 1880 MHz 2/Hearing Aid Compatibility Test (101x451x1):

Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 145.2 V/m
Probe Modulation Factor = 1.00
Reference Value = 164.8 V/m; Power Drift = 0.000 dB

Peak E-field in V/m

Grid 1 **136.6**	Grid 2 **143.3**	Grid 3 **141.4**
Grid 4 **96.3**	Grid 5 **98.9**	Grid 6 **96.8**
Grid 7 **136.3**	Grid 8 **145.2**	Grid 9 **143.8**



0 dB = 145.2V/m

DUT: HAC-Dipole 835 MHz; Serial: SN:1021
Program Name: HAC H Dipole
Procedure Name: H Scan 10mm above CD 835 MHz

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

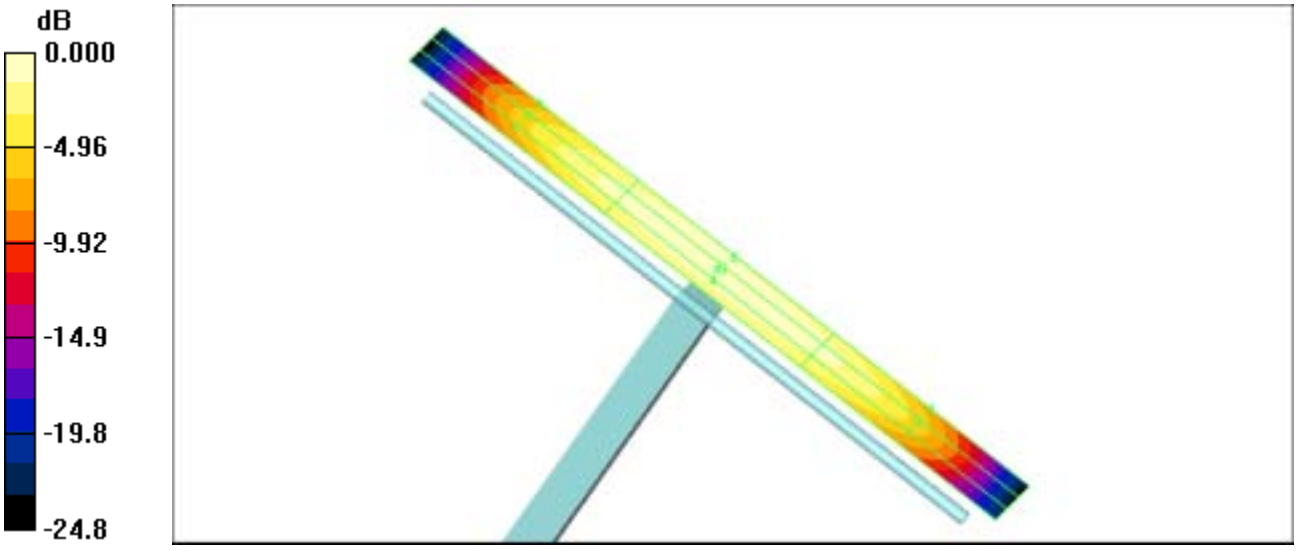
DASY4 Configuration:
- Probe: H3DV6 - SN6159; ; Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

H Scan 10mm above CD 835 MHz/Hearing Aid Compatibility Test (41x361x1):

Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.444 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.476 A/m; Power Drift = -0.081 dB

Peak H-field in A/m

Grid 1 **0.368**	Grid 2 **0.399**	Grid 3 **0.387**
Grid 4 **0.409**	Grid 5 **0.444**	Grid 6 **0.434**
Grid 7 **0.364**	Grid 8 **0.397**	Grid 9 **0.389**



0 dB = 0.444A/m

DUT: HAC Dipole 1880 MHz; Serial: SN:1016
Program Name: HAC H Dipole
Procedure Name: H Scan 10mm above CD 1880 MHz

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

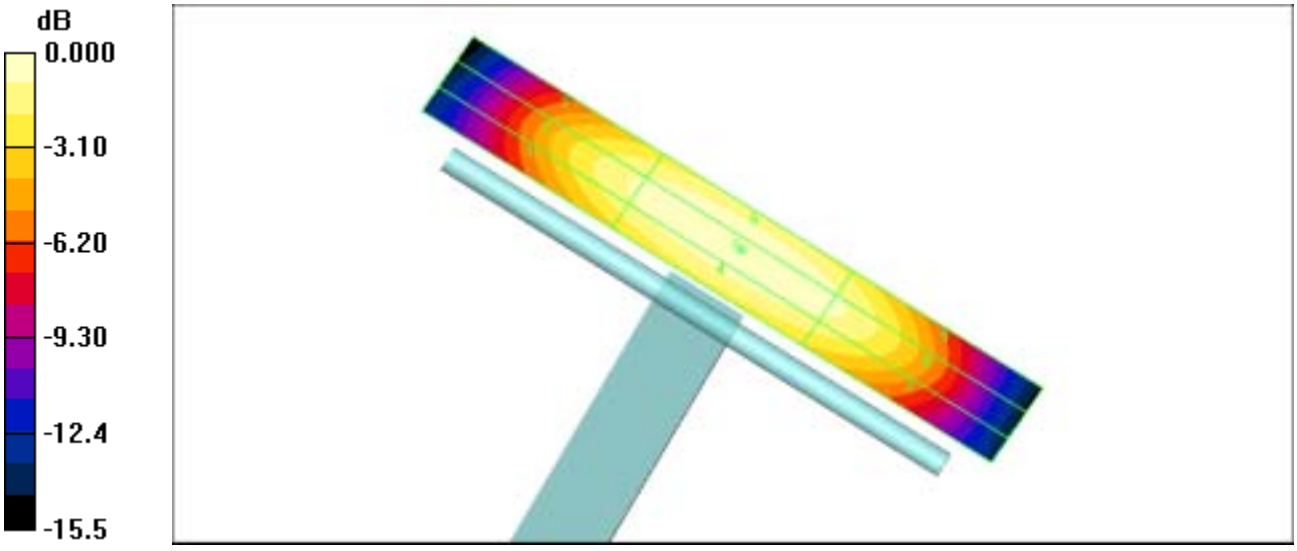
DASY4 Configuration:
- Probe: H3DV6 - SN6159; ; Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

H Scan 10mm above CD 1880 MHz/Hearing Aid Compatibility Test (41x181x1):

Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.433 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.457 A/m; Power Drift = -0.063 dB

Peak H-field in A/m

Grid 1 **0.371**	Grid 2 **0.395**	Grid 3 **0.384**
Grid 4 **0.405**	Grid 5 **0.433**	Grid 6 **0.423**
Grid 7 **0.372**	Grid 8 **0.400**	Grid 9 **0.391**



0 dB = 0.433A/m

APPENDIX E

Plots of The HAC Measurements

DUT: SPH-M510; Serial: FD-200-G
Program Name: SPH-M510(CDMA)
Procedure Name: Ch.1013, Ant, Intenna, Bat. Standard (RC3,SO55)

Communication System: CDMA(HAC); Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Device Section

DASY4 Configuration:
- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch.1013, Ant, Intenna, Bat. Standard/Hearing Aid Compatibility Test

(251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 54.7 V/m
Probe Modulation Factor = 1.00
Reference Value = 53.6 V/m; Power Drift = 0.058 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **40.7**	Grid 2 **50.4**	Grid 3 **50.7**
Grid 4 **41.6**	Grid 5 **54.2**	Grid 6 **54.7**
Grid 7 **38.0**	Grid 8 **51.1**	Grid 9 **51.8**

0 dB = 54.7V/m

DUT: SPH-M510; Serial: FD-200-G
Program Name: SPH-M510(CDMA)
Procedure Name: Ch.384, Ant, Intenna, Bat. Standard (RC3,SO55)

Communication System: CDMA(HAC); Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Device Section

DASY4 Configuration:
- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch.384, Ant, Intenna, Bat. Standard/Hearing Aid Compatibility Test

(251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 57.0 V/m
Probe Modulation Factor = 1.00
Reference Value = 50.9 V/m; Power Drift = -0.147 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **37.6**	Grid 2 **51.1**	Grid 3 **51.7**
Grid 4 **39.8**	Grid 5 **56.1**	Grid 6 **57.0**
Grid 7 **38.7**	Grid 8 **53.8**	Grid 9 **54.7**

0 dB = 57.0V/m

DUT: SPH-M510; Serial: FD-200-G
Program Name: SPH-M510(CDMA)
Procedure Name: Ch.777, Ant, Intenna, Bat. Standard (RC3,SO55)

Communication System: CDMA(HAC); Frequency: 848.31 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Device Section

DASY4 Configuration:
- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch.777, Ant, Intenna, Bat. Standard/Hearing Aid Compatibility Test

(251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 61.5 V/m
Probe Modulation Factor = 1.00
Reference Value = 54.1 V/m; Power Drift = 0.075 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **43.1**	Grid 2 **56.0**	Grid 3 **57.4**
Grid 4 **42.0**	Grid 5 **59.5**	Grid 6 **61.5**
Grid 7 **38.3**	Grid 8 **56.5**	Grid 9 **58.5**

0 dB = 61.5V/m

DUT: SPH-M510; Serial: FD-200-G
Program Name: SPH-M510(PCS)
Procedure Name: Ch.25, Ant, Intenna, Battery Standard

Communication System: PCS; Frequency: 1851.25 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Device Section

DASY4 Configuration:
- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch.25, Ant, Intenna, Battery Standard/Hearing Aid Compatibility Test

(251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 53.4 V/m
Probe Modulation Factor = 1.05
Reference Value = 33.4 V/m; Power Drift = -0.131 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **25.0**	Grid 2 **39.3**	Grid 3 **41.8**
Grid 4 **26.3**	Grid 5 **49.6**	Grid 6 **53.4**
Grid 7 **40.9**	Grid 8 **51.4**	Grid 9 **52.8**

0 dB = 53.4V/m

DUT: SPH-M510; Serial: FD-200-G
Program Name: SPH-M510(PCS)
Procedure Name: Ch.600, Ant, Intenna, Battery Standard

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

DASY4 Configuration:
- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch.600, Ant, Intenna, Battery Standard/Hearing Aid Compatibility Test

(251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 50.9 V/m
Probe Modulation Factor = 1.05
Reference Value = 29.8 V/m; Power Drift = -0.119 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **30.6**	Grid 2 **35.4**	Grid 3 **40.6**
Grid 4 **27.1**	Grid 5 **45.2**	Grid 6 **50.9**
Grid 7 **40.0**	Grid 8 **47.5**	Grid 9 **50.4**

0 dB = 50.9V/m

DUT: SPH-M510; Serial: FD-200-G
Program Name: SPH-M510(PCS)
Procedure Name: Ch.1175, Ant, Intenna, Battery Standard

Communication System: PCS; Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Device Section

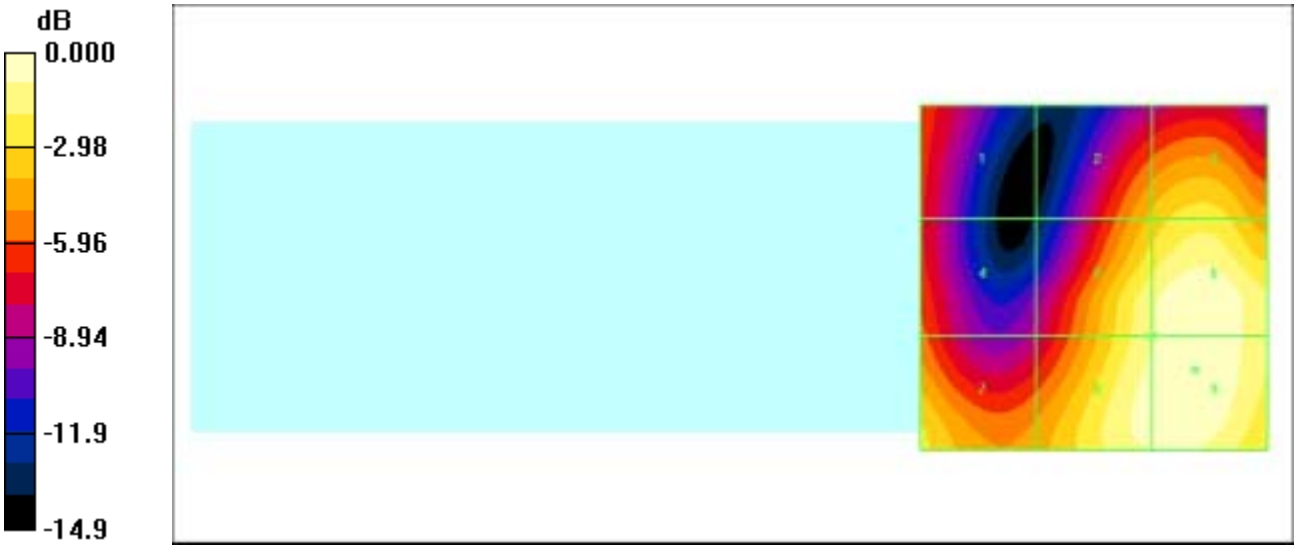
DASY4 Configuration:
- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch.1175, Ant, Intenna, Battery Standard/Hearing Aid Compatibility Test

(251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 54.6 V/m
Probe Modulation Factor = 1.05
Reference Value = 29.4 V/m; Power Drift = -0.148 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **26.4**	Grid 2 **35.9**	Grid 3 **41.4**
Grid 4 **28.8**	Grid 5 **48.4**	Grid 6 **54.6**
Grid 7 **40.4**	Grid 8 **51.8**	Grid 9 **54.6**



0 dB = 54.6V/m

DUT: SCH-M510; Serial: FD-200-G
Program Name: SPH-M510(PCS)
Procedure Name: Ch.1175, Ant, Intenna, Battery Standard Backlight ON

Communication System: PCS; Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Device Section

DASY4 Configuration:
- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch.1175, Ant, Intenna, Battery Standard 2/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm

Maximum value of peak Total field = 51.6 V/m
Probe Modulation Factor = 1.05
Reference Value = 30.1 V/m; Power Drift = -0.185 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **30.1**	Grid 2 **32.0**	Grid 3 **29.2**
Grid 4 **39.4**	Grid 5 **45.9**	Grid 6 **44.8**
Grid 7 **40.3**	Grid 8 **51.5**	Grid 9 **51.6**

0 dB = 51.6V/m

DUT: SPH-M510; Serial: FD-200-G
Program Name: SPH-M510(CDMA)
Procedure Name: Ch.1013, Ant. Intenna, Battery Standard

Communication System: CDMA(HAC); Frequency: 824.7 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: E Device Section

DASY4 Configuration:
- Probe: H3DV6 - SN6159; ; Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch.1013, Ant. Intenna, Battery Standard/Hearing Aid Compatibility Test

(251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 0.116 A/m
Probe Modulation Factor = 1.06
Reference Value = 0.065 A/m; Power Drift = -0.052 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.099**	Grid 2 **0.076**	Grid 3 **0.050**
Grid 4 **0.111**	Grid 5 **0.084**	Grid 6 **0.054**
Grid 7 **0.116**	Grid 8 **0.087**	Grid 9 **0.055**

0 dB = 0.116A/m

DUT: SPH-M510; Serial: FD-200-G
Program Name: SPH-M510(CDMA)
Procedure Name: Ch.384, Ant. Intenna, Battery Standard

Communication System: CDMA(HAC); Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: E Device Section

DASY4 Configuration:
- Probe: H3DV6 - SN6159; ; Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch.384, Ant. Intenna, Battery Standard/Hearing Aid Compatibility Test

(251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 0.144 A/m
Probe Modulation Factor = 1.06
Reference Value = 0.075 A/m; Power Drift = -0.165 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.125**	Grid 2 **0.092**	Grid 3 **0.056**
Grid 4 **0.135**	Grid 5 **0.101**	Grid 6 **0.063**
Grid 7 **0.144**	Grid 8 **0.106**	Grid 9 **0.068**

0 dB = 0.144A/m

DUT: SPH-M510; Serial: FD-200-G
Program Name: SPH-M510(CDMA)
Procedure Name: Ch.777, Ant. Intenna, Battery Standard

Communication System: CDMA(HAC); Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: E Device Section

DASY4 Configuration:
- Probe: H3DV6 - SN6159; ; Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch.777, Ant. Intenna, Battery Standard/Hearing Aid Compatibility Test

(251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 0.124 A/m
Probe Modulation Factor = 1.06
Reference Value = 0.064 A/m; Power Drift = -0.022 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.106**	Grid 2 **0.080**	Grid 3 **0.049**
Grid 4 **0.118**	Grid 5 **0.088**	Grid 6 **0.056**
Grid 7 **0.124**	Grid 8 **0.094**	Grid 9 **0.060**

0 dB = 0.124A/m

DUT: SPH-M510; Serial: FD-200-G
Program Name: SPH-U540(PCS)
Procedure Name: Ch.25, Ant. Intenna, Battery Standard

Communication System: PCS; Frequency: 1851.25 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: E Device Section

DASY4 Configuration:
- Probe: H3DV6 - SN6159; ; Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch.25, Ant. Intenna, Battery Standard/Hearing Aid Compatibility Test

(251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 0.220 A/m
Probe Modulation Factor = 1.01
Reference Value = 0.159 A/m; Power Drift = 0.075 dB
Hearing Aid Near-Field Category: M3 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.183**	Grid 2 **0.175**	Grid 3 **0.122**
Grid 4 **0.206**	Grid 5 **0.195**	Grid 6 **0.136**
Grid 7 **0.220**	Grid 8 **0.207**	Grid 9 **0.144**

0 dB = 0.220A/m

DUT: SPH-M510; Serial: FD-200-G
Program Name: SPH-U540(PCS)
Procedure Name: Ch.0600, Ant. Intenna, Battery Standard

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

DASY4 Configuration:
- Probe: H3DV6 - SN6159; ; Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch.0600, Ant. Intenna, Battery Standard/Hearing Aid Compatibility Test

(251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 0.169 A/m
Probe Modulation Factor = 1.01
Reference Value = 0.121 A/m; Power Drift = -0.014 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.142**	Grid 2 **0.136**	Grid 3 **0.097**
Grid 4 **0.156**	Grid 5 **0.147**	Grid 6 **0.100**
Grid 7 **0.169**	Grid 8 **0.158**	Grid 9 **0.111**

0 dB = 0.169A/m

DUT: SPH-M510; Serial: FD-200-G
Program Name: SPH-U540(PCS)
Procedure Name: Ch.1175, Ant. Intenna, Battery Standard

Communication System: PCS; Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: E Device Section

DASY4 Configuration:
- Probe: H3DV6 - SN6159; ; Calibrated: 2006-09-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn486; Calibrated: 2006-07-17
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Ch.1175, Ant. Intenna, Battery Standard/Hearing Aid Compatibility Test

(251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 0.180 A/m
Probe Modulation Factor = 1.01
Reference Value = 0.118 A/m; Power Drift = -0.132 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.139**	Grid 2 **0.130**	Grid 3 **0.088**
Grid 4 **0.163**	Grid 5 **0.146**	Grid 6 **0.093**
Grid 7 **0.180**	Grid 8 **0.159**	Grid 9 **0.107**

0 dB = 0.180A/m

APPENDIX F

Probe Calibration(E-field)

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 **Samsung El. (Dymstec)**

Certificate No: ER3-2342_Sep06

CALIBRATION CERTIFICATE

Object	ER3DV6 - SN:2342
Calibration procedure(s)	QA CAL-02.v4 Calibration procedure for E-field probes optimized for close near field evaluations in air
Calibration date:	September 20, 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	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41495277	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41498067	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-06 (METAS, No. 217-00592)	Aug-07
Reference 20 dB Attenuator	SN: S5086 (20b)	4-Apr-06 (METAS, No. 251-00558)	Apr-07
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-06 (METAS, No. 217-00593)	Aug-07
Reference Probe ER3DV6	SN: 2328	3-Oct-05 (SPEAG, No. ER3-2328_Oct05)	Oct-06
DAE4	SN: 654	21-Jun-06 (SPEAG, No. DAE4-654_Jun06)	Jun-07

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

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

Issued: September 20, 2006

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

NOV. 16. 2006

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., $\vartheta = 0$ 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 $\vartheta = 0$ 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 = NORMx,y,z * frequency_response* (see Frequency Response Chart).
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency.
- *Spherical isotropy (3D deviation from isotropy)*: in a locally homogeneous field realized using an open waveguide setup.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe ER3DV6

SN:2342

Manufactured:	January 1, 2005
Last calibrated:	April 27, 2005
Recalibrated:	September 20, 2006

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ER3DV6 SN:2342

Sensitivity in Free Space [$\mu V/(V/m)^2$]

NormX	**1.63** ± 10.1 % (k=2)
NormY	**1.34** ± 10.1 % (k=2)
NormZ	**1.75** ± 10.1 % (k=2)

Diode Compression[A]

DCP X	**84** mV
DCP Y	**84** mV
DCP Z	**95** 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

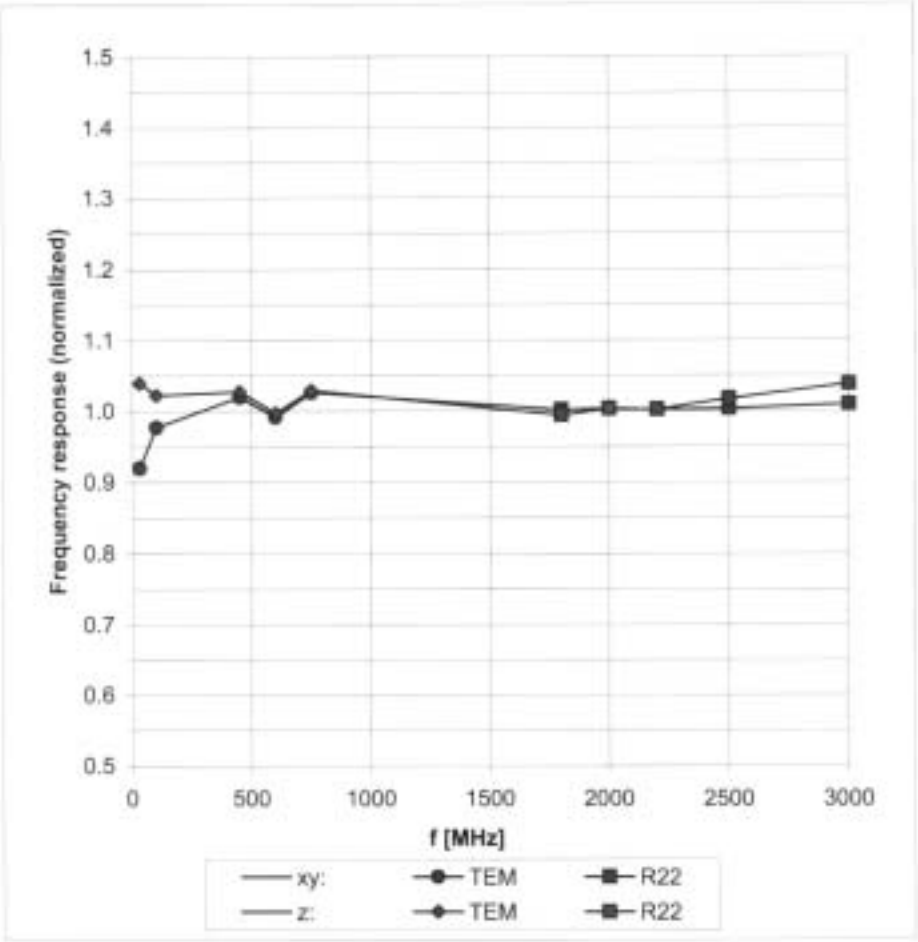
Connector Angle **27** °

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

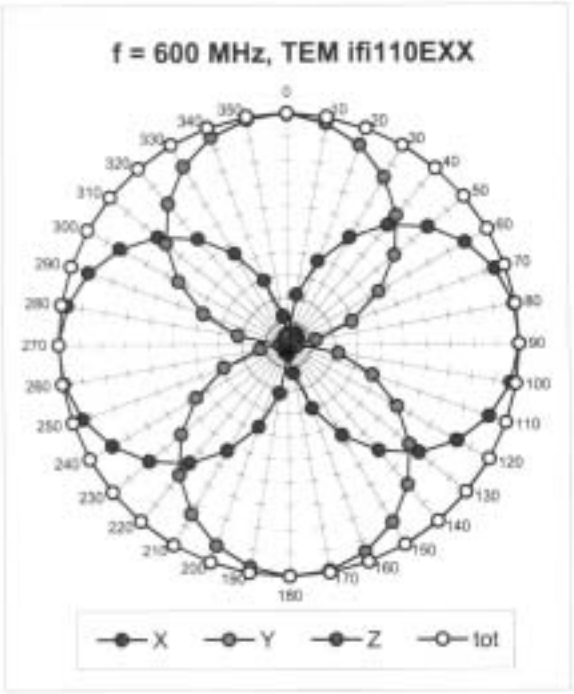
Frequency Response of E-Field

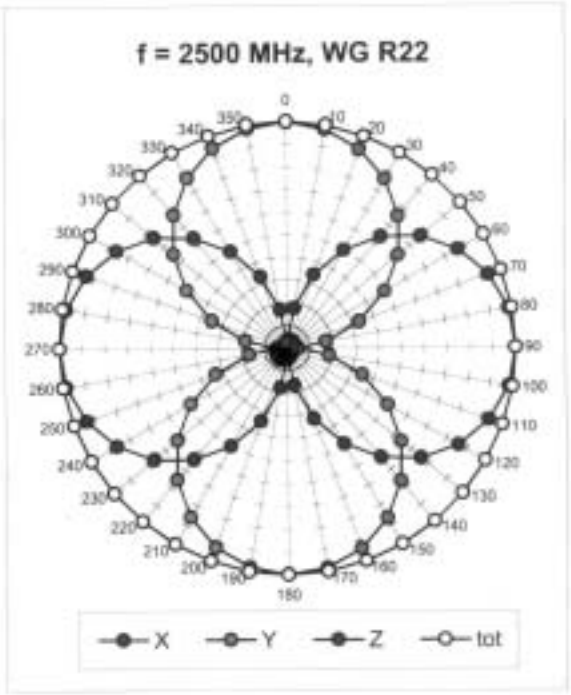
(TEM-Cell:ifi110 EXX, Waveguide R22)



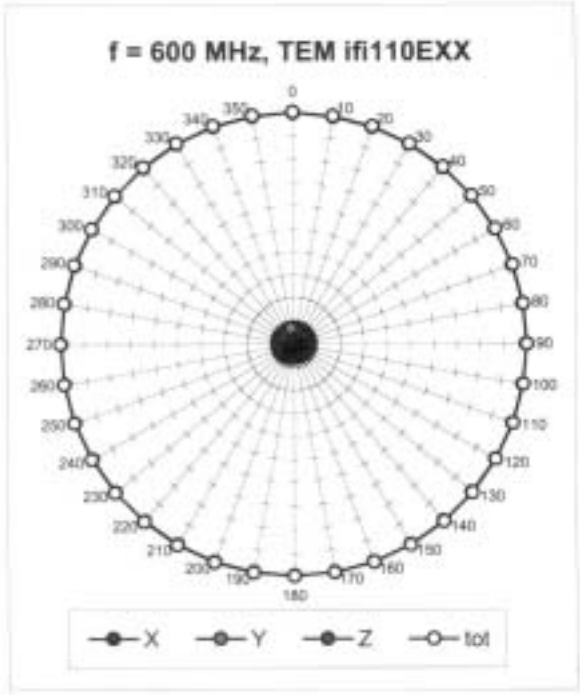
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

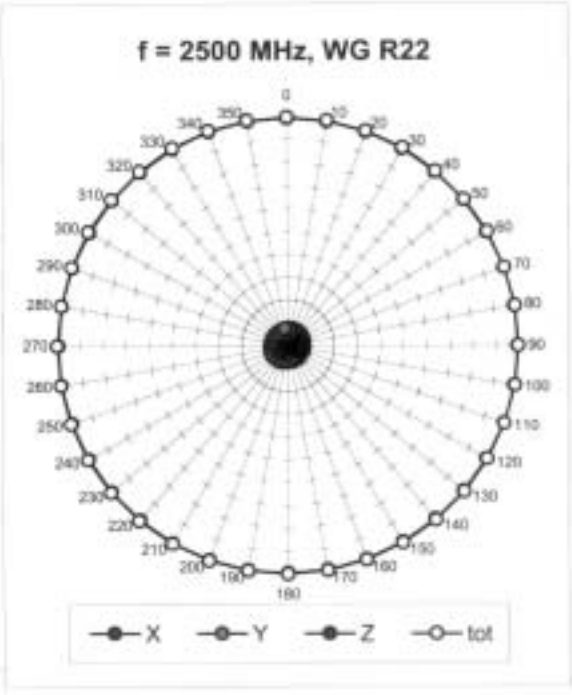
Receiving Pattern (ϕ), ϑ = 0°



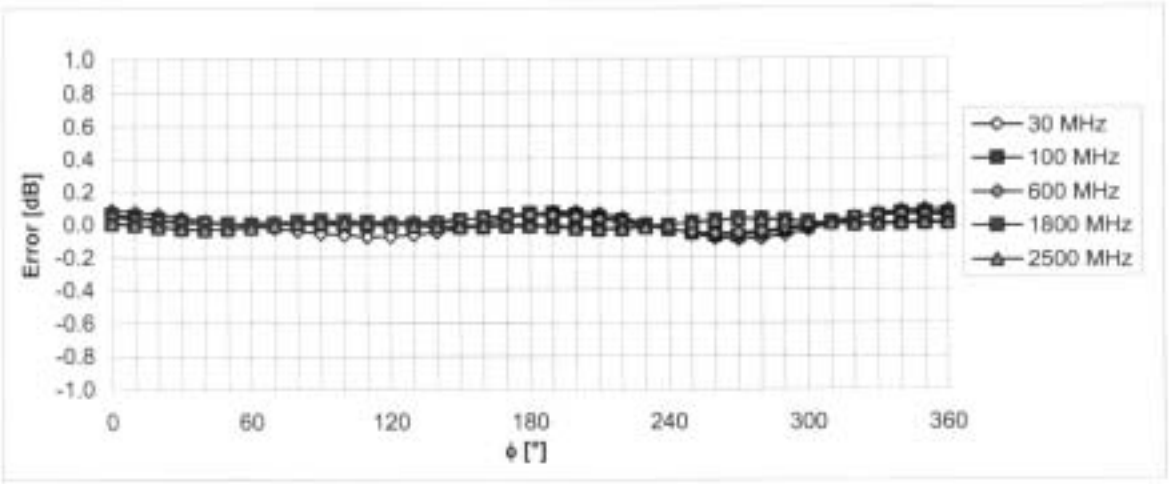


Receiving Pattern (ϕ), ϑ = 90°



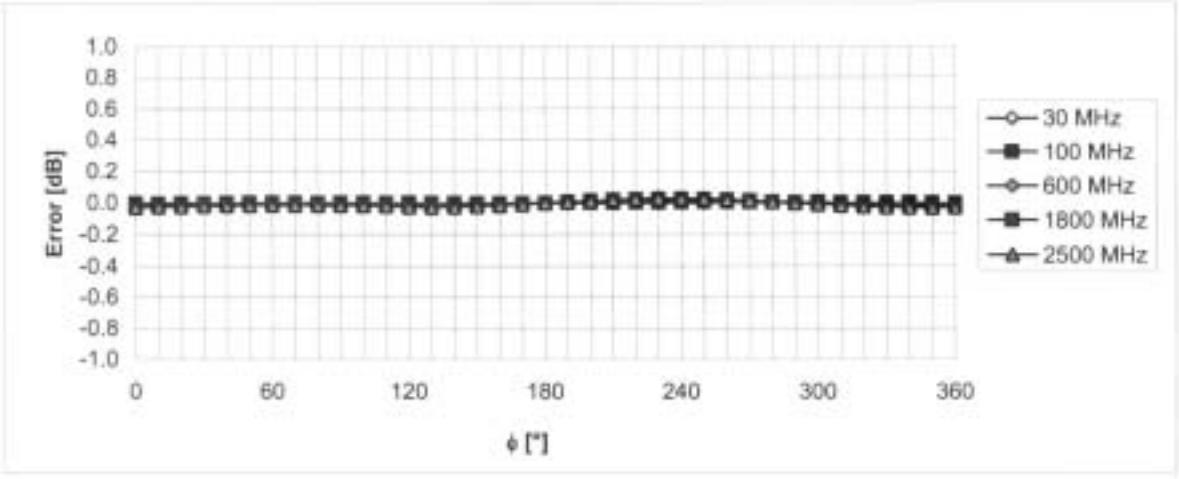


Receiving Pattern (ϕ), ϑ = 0°



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

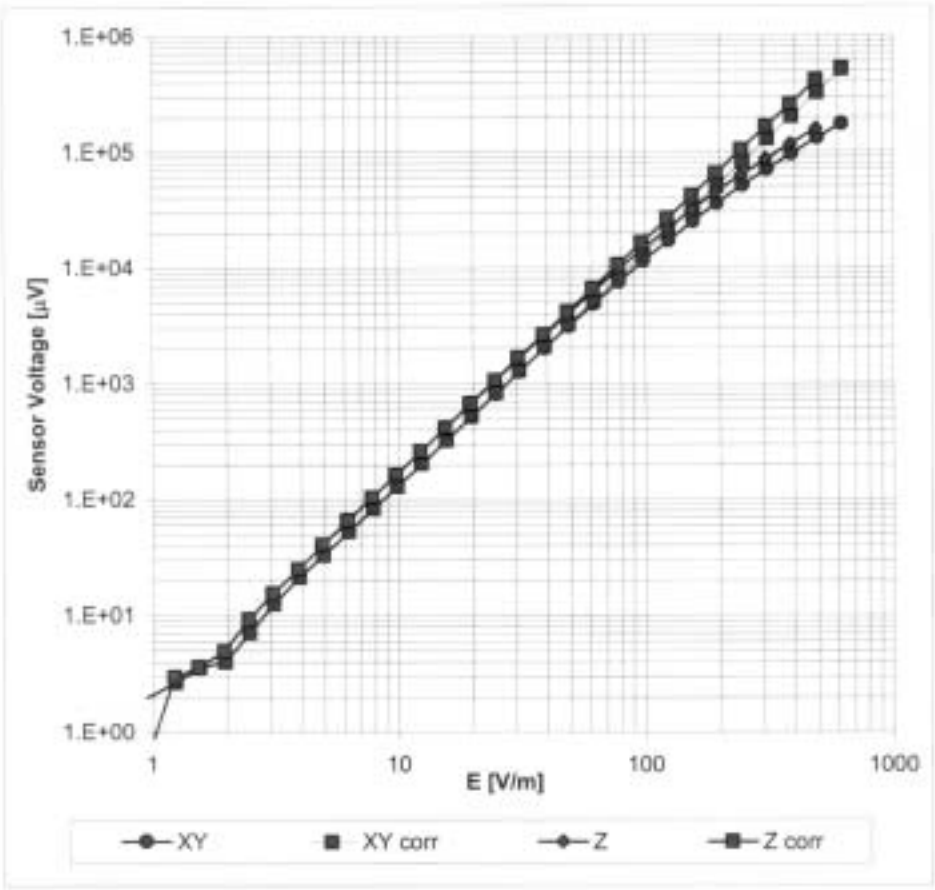
Receiving Pattern (ϕ), ϑ = 90°

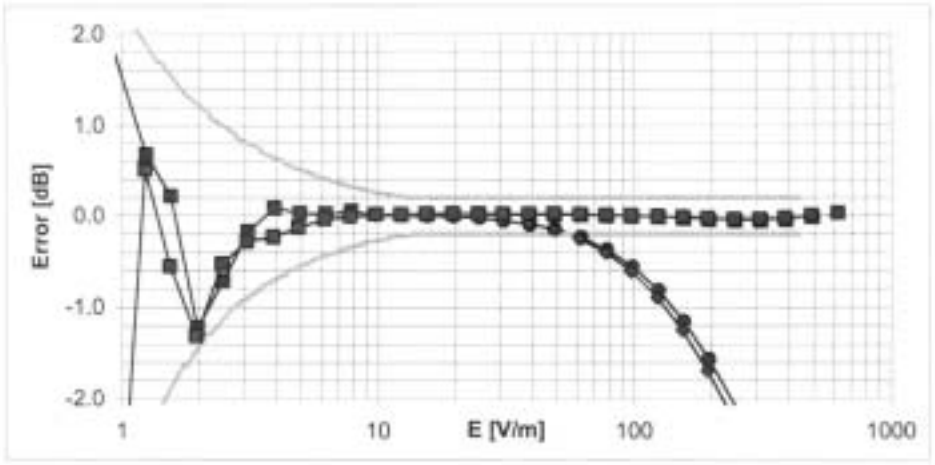


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(E-field)

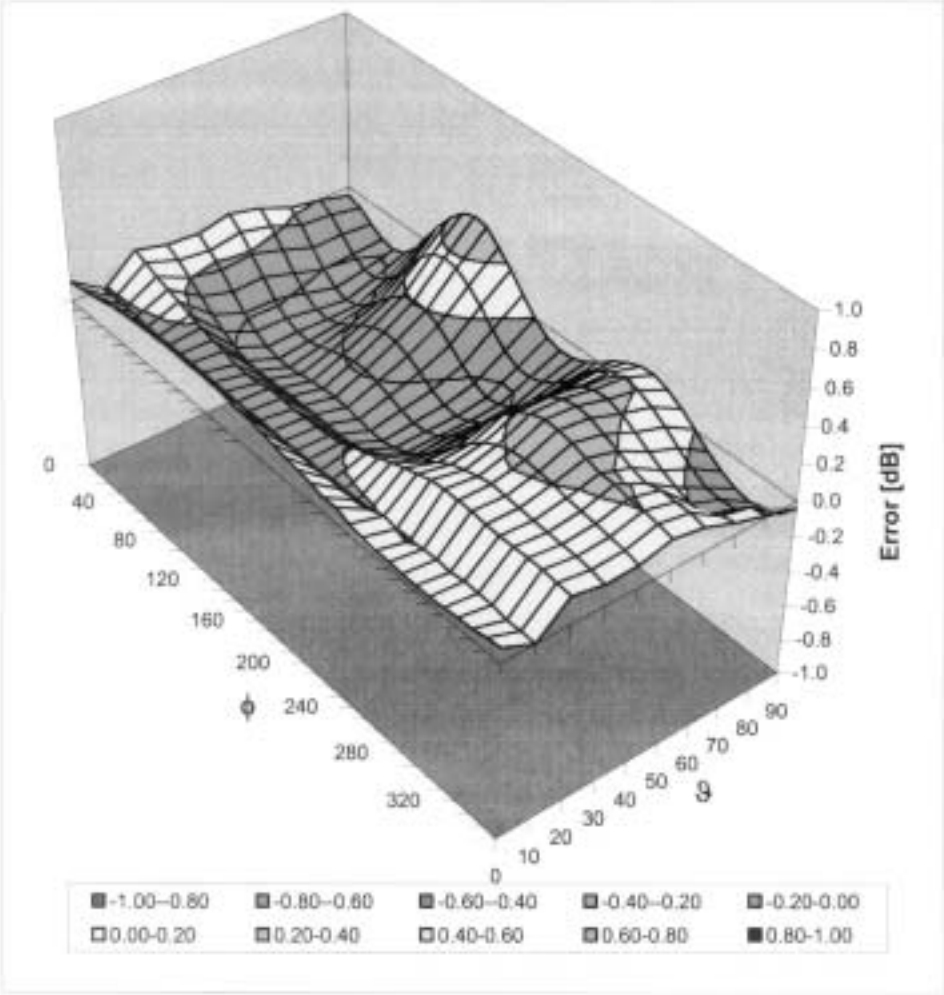
(Waveguide R22, f = 1800 MHz)





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

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



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

APPENDIX F

Probe Calibration(H-field)

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 **Samsung El. (Dymstec)**

Certificate No: H3-6159_Sep06

CALIBRATION CERTIFICATE

Object	H3DV6 - SN:6159
Calibration procedure(s)	QA CAL-03.v4 Calibration procedure for H-field probes optimized for close near field evaluations in air
Calibration date:	September 20, 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	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41495277	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41498087	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-06 (METAS, No. 217-00592)	Aug-07
Reference 20 dB Attenuator	SN: S5086 (20b)	4-Apr-06 (METAS, No. 251-00558)	Apr-07
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-06 (METAS, No. 217-00593)	Aug-07
Reference Probe H3DV6	SN: 6182	3-Oct-05 (SPEAG, No. H3-6182_Oct05)	Oct-06
DAE4	SN: 654	21-Jun-06 (SPEAG, No. DAE4-654_Jun06)	Jun-07

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

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

Issued: September 20, 2006

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

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., $\vartheta = 0$ 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 $\vartheta = 90$ 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* 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:6159

Manufactured:	July 9, 2004
Last calibrated:	April 26, 2005
Recalibrated:	September 20, 2006

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: H3DV6 SN:6159

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

	a0	a1	a2	
X	**2.599E-03**	**-4.570E-5**	**-5.141E-6**	± 5.1 % (k=2)
Y	**2.587E-03**	**-8.732E-6**	**1.530E-5**	± 5.1 % (k=2)
Z	**3.009E-03**	**-1.690E-4**	**-2.448E-5**	± 5.1 % (k=2)

Diode Compression[1]

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

Sensor Offset (Probe Tip to Sensor Center)

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

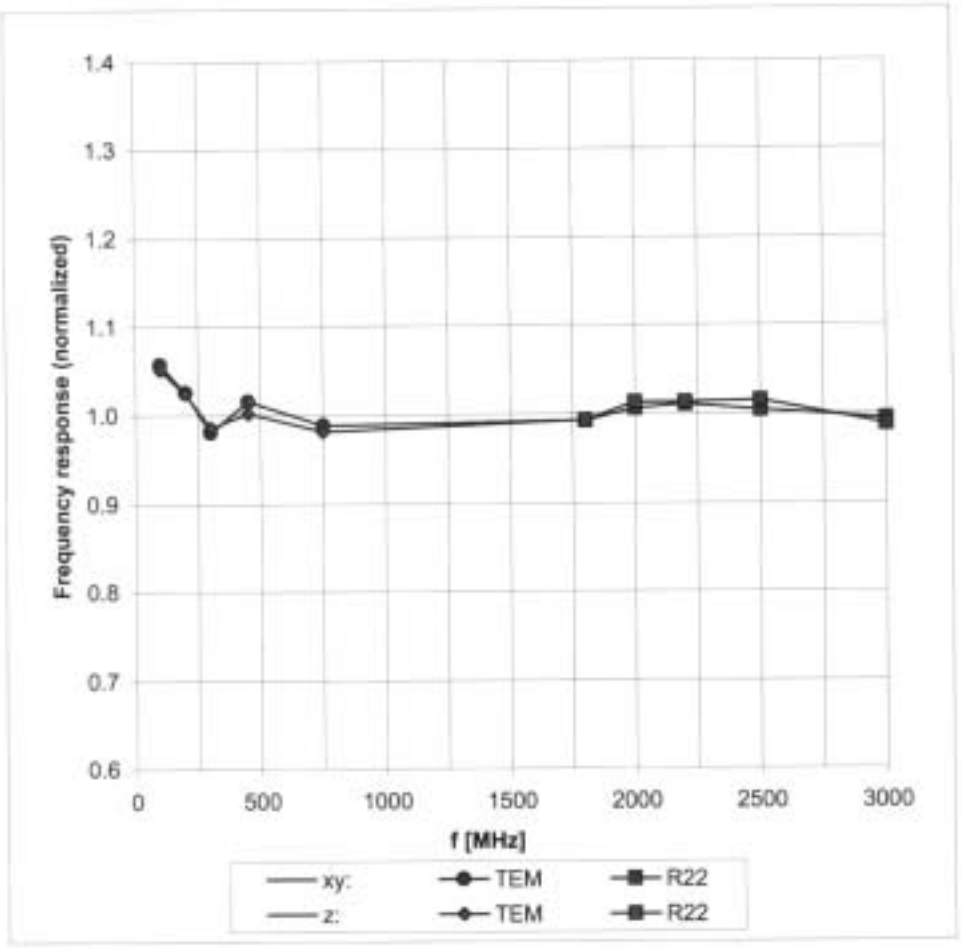
Connector Angle **-105** °

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

Frequency Response of H-Field

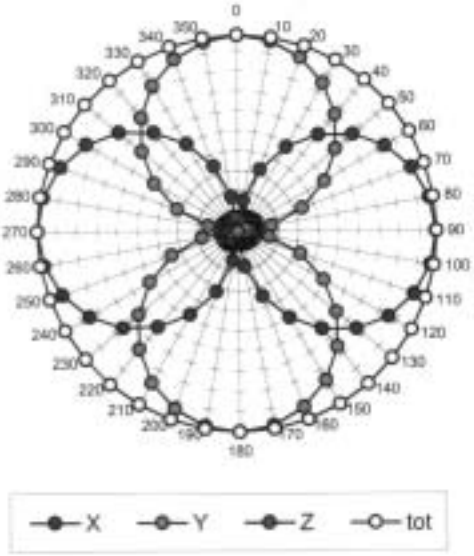
(TEM-Cell:ifi110, Waveguide R22)



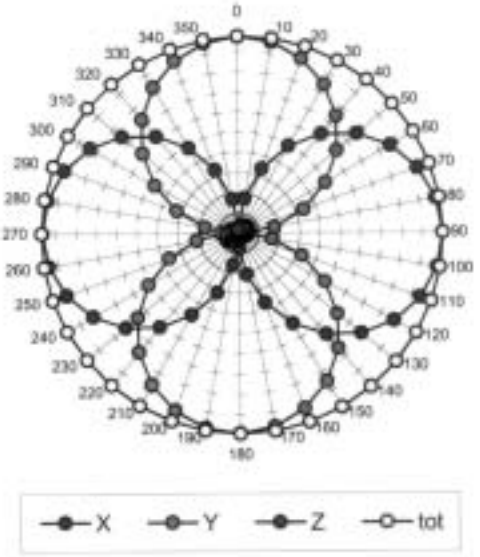
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 90°

f = 300 MHz, TEM ifi110EXX

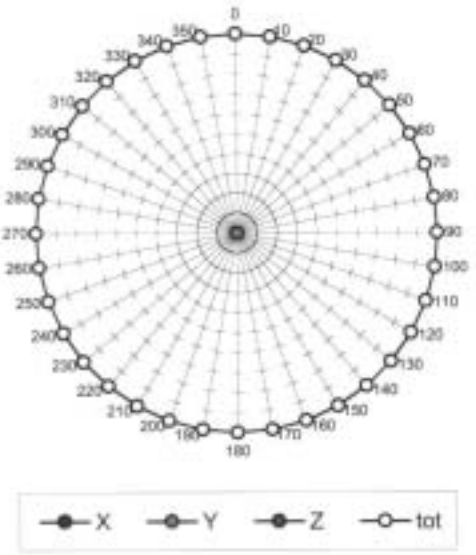


f = 2500 MHz, WG R22

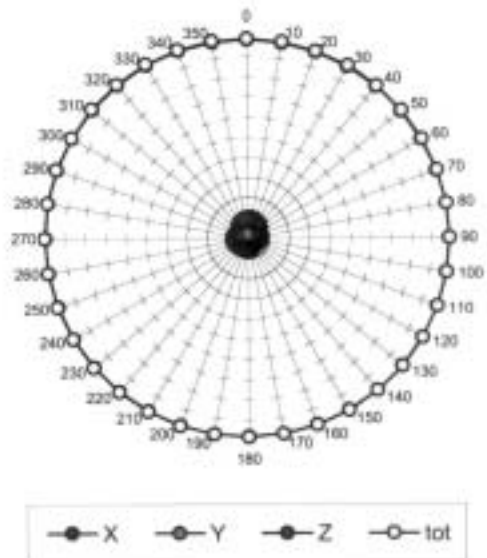


Receiving Pattern (ϕ), ϑ = 0°

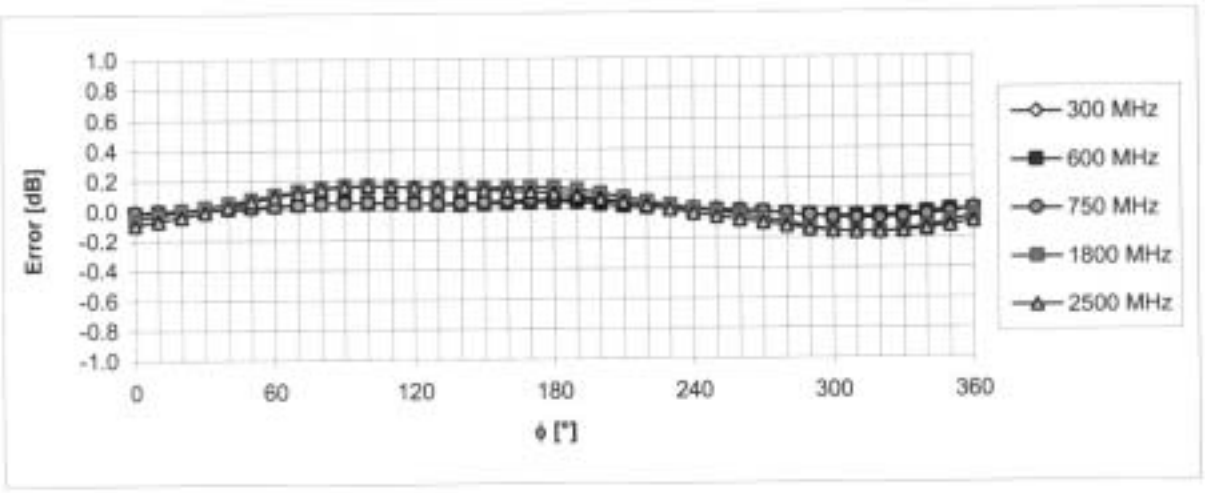
f = 300 MHz, TEM ifi110EXX



f = 2500 MHz, WG R22

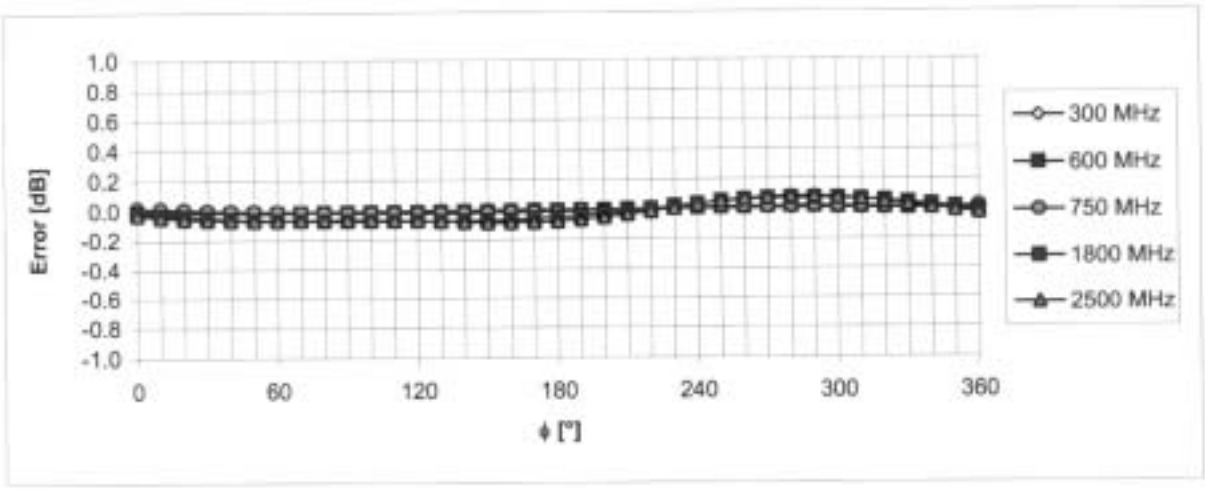


Receiving Pattern (ϕ), ϑ = 90°



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

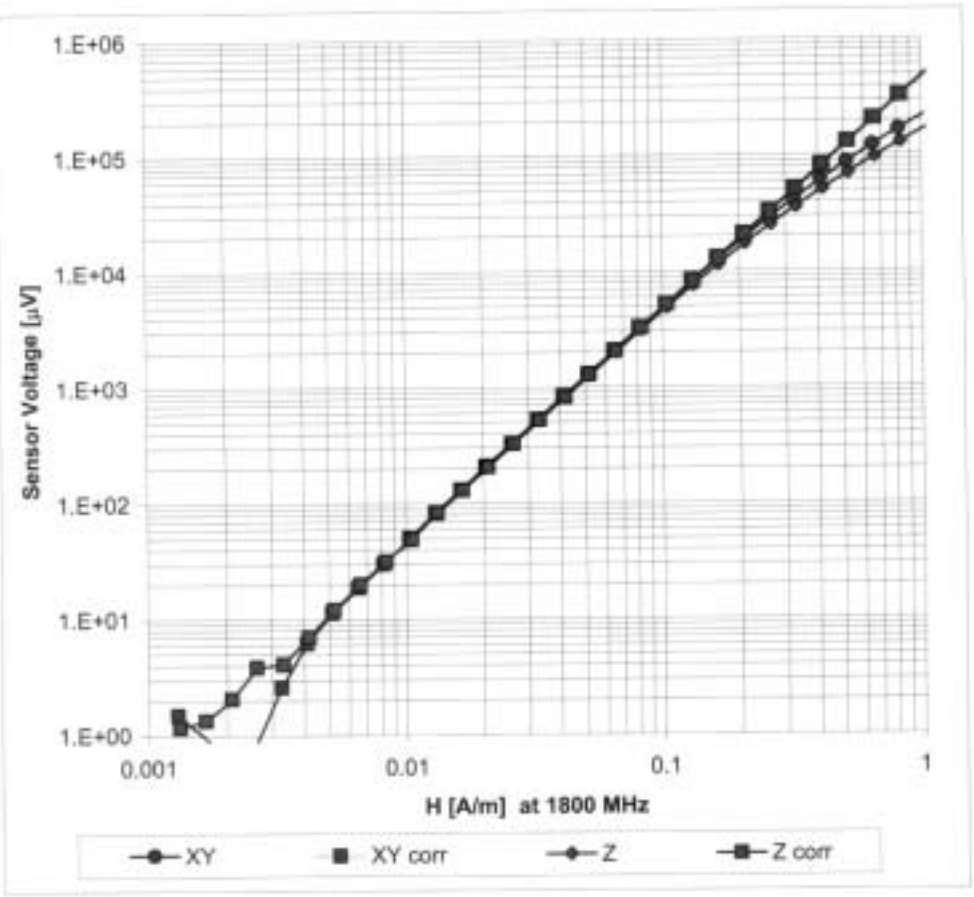
Receiving Pattern (ϕ), ϑ = 0°

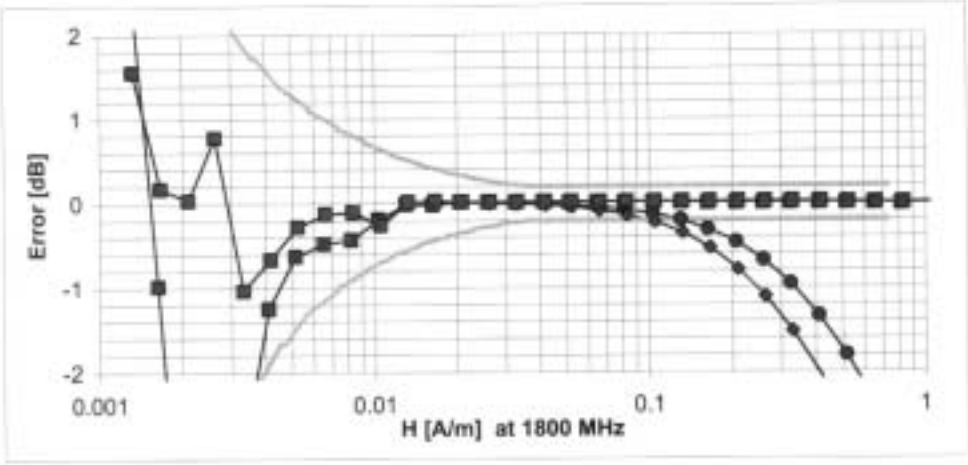


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(H-field)

(Waveguide R22, f = 1800 MHz)





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

APPENDIX G

Calibration of The Validation Dipole

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

SOP1

Client **Samsung Suwon (Dymstec)**

Certificate No: **CD835V3-1021_Apr05**

CALIBRATION CERTIFICATE

Object	CD835V3 - SN: 1021
Calibration procedure(s)	QA CAL-20.v3 Calibration procedure for dipoles in air
Calibration date:	April 27, 2005
Condition of the calibrated item	In Tolerance

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Power sensor HP 8481A	US37292783	12-Oct-04 (METAS, No. 251-00412)	Oct-05
20 dB Attenuator	SN: 5086 (20g)	10-Aug-04 (METAS, No 251-00402)	Aug-05
10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-04 (METAS, No 251-00402)	Aug-05

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-4419B	GB43310788	10-Aug-03 (SPEAG, in house check Jan-04)	In house check: Oct-05
Power sensor HP 8481A	MY41092312	10-Aug-03 (SPEAG, in house check Jan-04)	In house check: Oct-05
Power sensor HP 8481A	MY41093315	10-Aug-03 (SPEAG, in house check Jan-04)	In house check: Oct-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov-05
RF generator R&S SMT06	1039.2000.06	26-Jul-04 (SPEAG, in house check Jul-04)	In house check: Jan-06
DAE4	SN: 901	29-Jun-04 (SPEAG, No. DAE4-901_Jun04)	Calibration, Jun-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	MMeili
Approved by:	Fin Bomholt	Technical Director	F. Bomholt

Issued: May 2, 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)

May 23, 2005

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

References

[1] ANSI-PC63.19-2003 (Draft)
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 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	V4.5 B19
DASY PP Version	SEMCAD	V1.8 B146
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	**0.439 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	163.6 V/m
Maximum measured above low end	100 mW forward power	170.5 V/m
Averaged maximum above arm	100 mW forward power	**167.1 V/m**

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

3 Appendix

3.1 Antenna Parameters

Frequency	**Return Loss**	**Impedance**
800 MHz	16.8 dB	(40.9 – j9.6) Ohm
835 MHz	**23.9 dB**	**(53.8 + j5.5) Ohm**
900 MHz	15.9 dB	(50.9 - j16.4) Ohm
950 MHz	21.5 dB	(45.9 + j6.9) Ohm
960 MHz	16.8 dB	(55.9 + j14.3) Ohm

3.2 Antenna Design and Handling

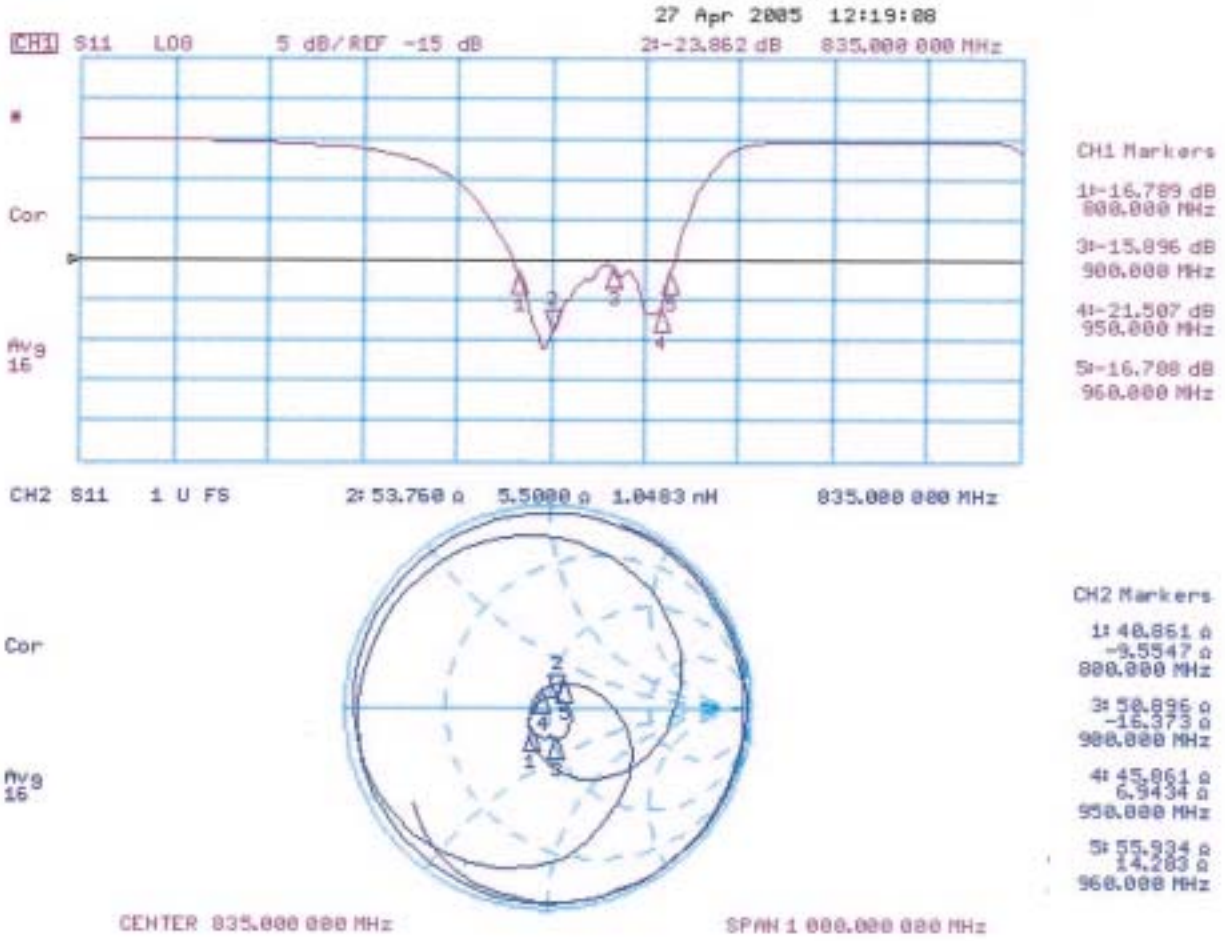
The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.
Do not apply force to dipole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

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

(C)10 -11- 10 Fok

3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



3.3.2 DASY4 H-field result

Date/Time: 4/27/2005 12:18:42 PM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1021

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
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 12/10/2004
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn901; Calibrated: 6/29/2004
- Phantom: HAC Phantom; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

H Scan 10mm above CD 835 MHz/Hearing Aid Compatibility Test (41x361x1):

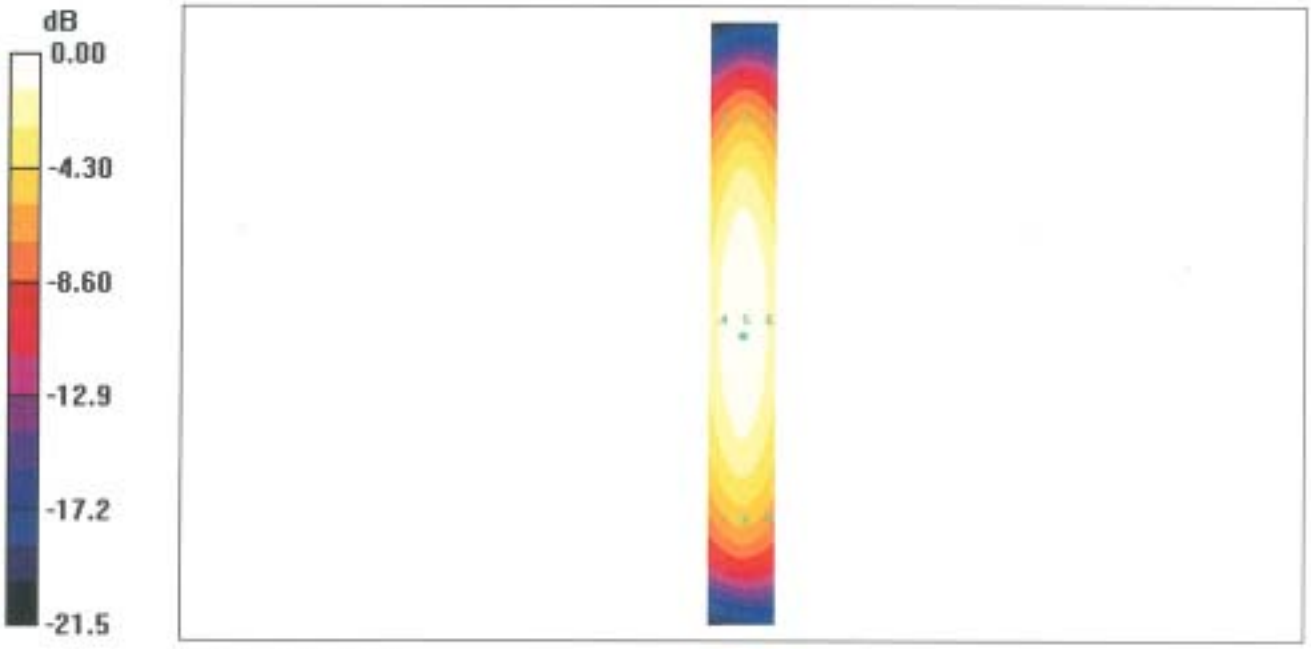
Measurement grid: dx=5mm, dy=5mm
Maximum value of Total field (slot averaged) = 0.439 A/m
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

H in A/m (Time averaged)

Grid 1 **0.362**	Grid 2 **0.390**	Grid 3 **0.372**
Grid 4 **0.410**	Grid 5 **0.439**	Grid 6 **0.421**
Grid 7 **0.364**	Grid 8 **0.390**	Grid 9 **0.373**

H in A/m (Slot averaged)

Grid 1 **0.362**	Grid 2 **0.390**	Grid 3 **0.372**
Grid 4 **0.410**	Grid 5 **0.439**	Grid 6 **0.421**
Grid 7 **0.364**	Grid 8 **0.390**	Grid 9 **0.373**



0 dB = 0.439A/m

3.3.3 DASY4 E-Field result

Date/Time: 4/27/2005 4:57:58 PM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1021

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
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 1/20/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn901; Calibrated: 6/29/2004
- Phantom: HAC Phantom; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

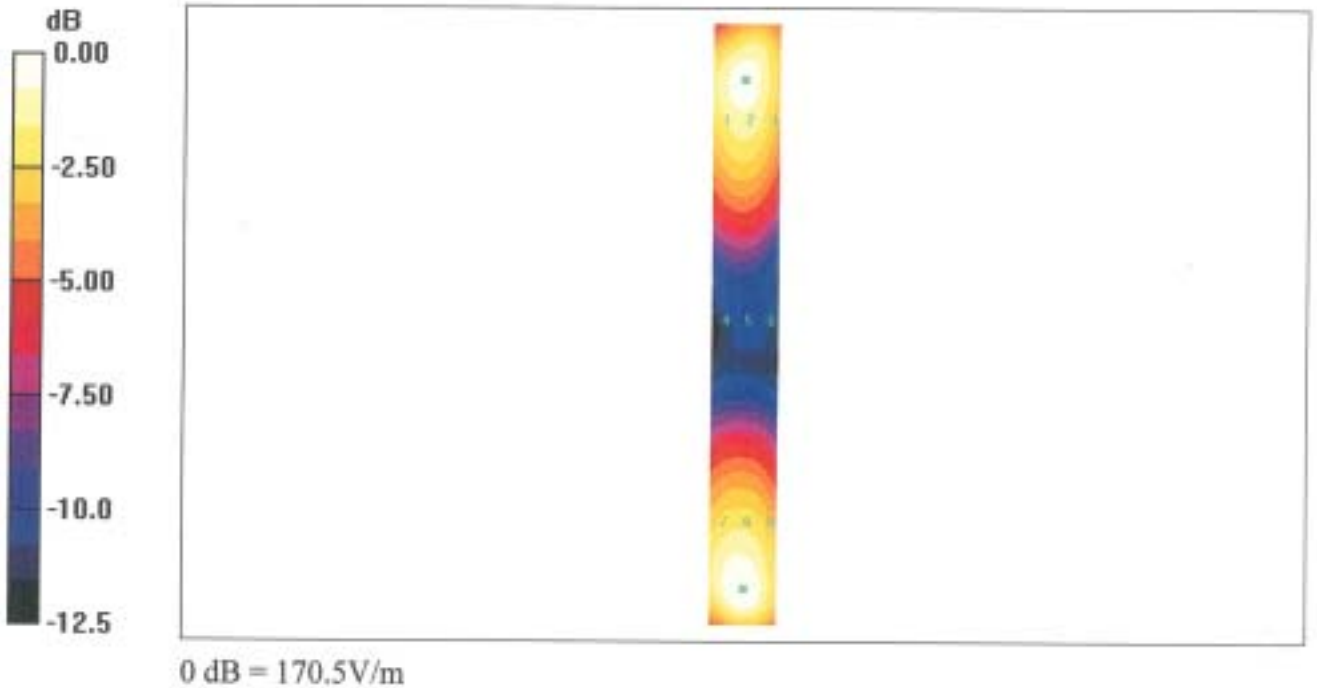
E Scan 10mm above CD 835 MHz/Hearing Aid Compatibility Test (41x361x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of Total field (slot averaged) = 170.5 V/m
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

E in V/m (Time averaged)

Grid 1 **159.9**	Grid 2 **163.6**	Grid 3 **156.4**
Grid 4 **86.0**	Grid 5 **88.0**	Grid 6 **83.6**
Grid 7 **163.7**	Grid 8 **170.5**	Grid 9 **164.4**

E in V/m (Slot averaged)

Grid 1 **159.9**	Grid 2 **163.6**	Grid 3 **156.4**
Grid 4 **86.0**	Grid 5 **88.0**	Grid 6 **83.6**
Grid 7 **163.7**	Grid 8 **170.5**	Grid 9 **164.4**



0 dB = 170.5V/m

sol-

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

Client **Samsung Suwon (Dymstec)**

Certificate No: **CD1880V3-1016_Apr05**

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1016
Calibration procedure(s)	QA CAL-20.v3 Calibration procedure for dipoles in air
Calibration date:	April 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 E442	GB37480704	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Power sensor HP 8481A	US37292783	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Reference 20 dB Attenuator	SN: 5086 (20g)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-04 (METAS, No 251-00402)	Aug-05

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	1926A29113	(in house check Apr-05)	In house check: Apr-06
Powermeter HP 436A	1949U00953	(in house check Apr-05)	In house check: Apr-06
Power sensor HP 8482A	1551A02446	cal. 13-Jun-2000 (in house check Apr-05)	In house check: Apr-06
Powermeter HP 436A	2410U02600	(in house check Apr-05)	In house check: Apr-06
RF generator Agilent E8251A	US41140111	4-Aug-03 (Agilent)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov-05
Reference Probe ER3DV6	SN 2336	20-Jan-05 (SPEAG, No. ER3-2336_Jan05)	Calibration, Jan-06
Probe H3DV6	SN 6065	10-Oct-04 (SPEAG, No. H3-6065-Oct04)	Calibration, Oct-05
DAE4	SN 901	29-Jun-04 (SPEAG, No. DAE4-901_Jun04)	Calibration, Jun-05

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

Issued: May 11, 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)

May 23, 2005

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

References

[1] ANSI-PC63.19-2003 (Draft)
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 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	V4.5 B19
DASY PP Version	SEMCAD	V1.8 B146
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	**0.457 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	137.2 V/m
Maximum measured above low end	100 mW forward power	139.9 V/m
Averaged maximum above arm	100 mW forward power	**138.6 V/m**

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

3 Appendix

3.1 Antenna Parameters

Frequency	**Return Loss**	**Impedance**
1710 MHz	20.4 dB	(57.0 + j7.6) Ohm
1880 MHz	**22.0 dB**	**(56.0 + j5.9) Ohm**
1900 MHz	23.4 dB	(56.2 + j3.5) Ohm
1950 MHz	33.1 dB	(51.4 – j1.8) Ohm
2000 MHz	18.5 dB	(44.5 + j9.8) Ohm

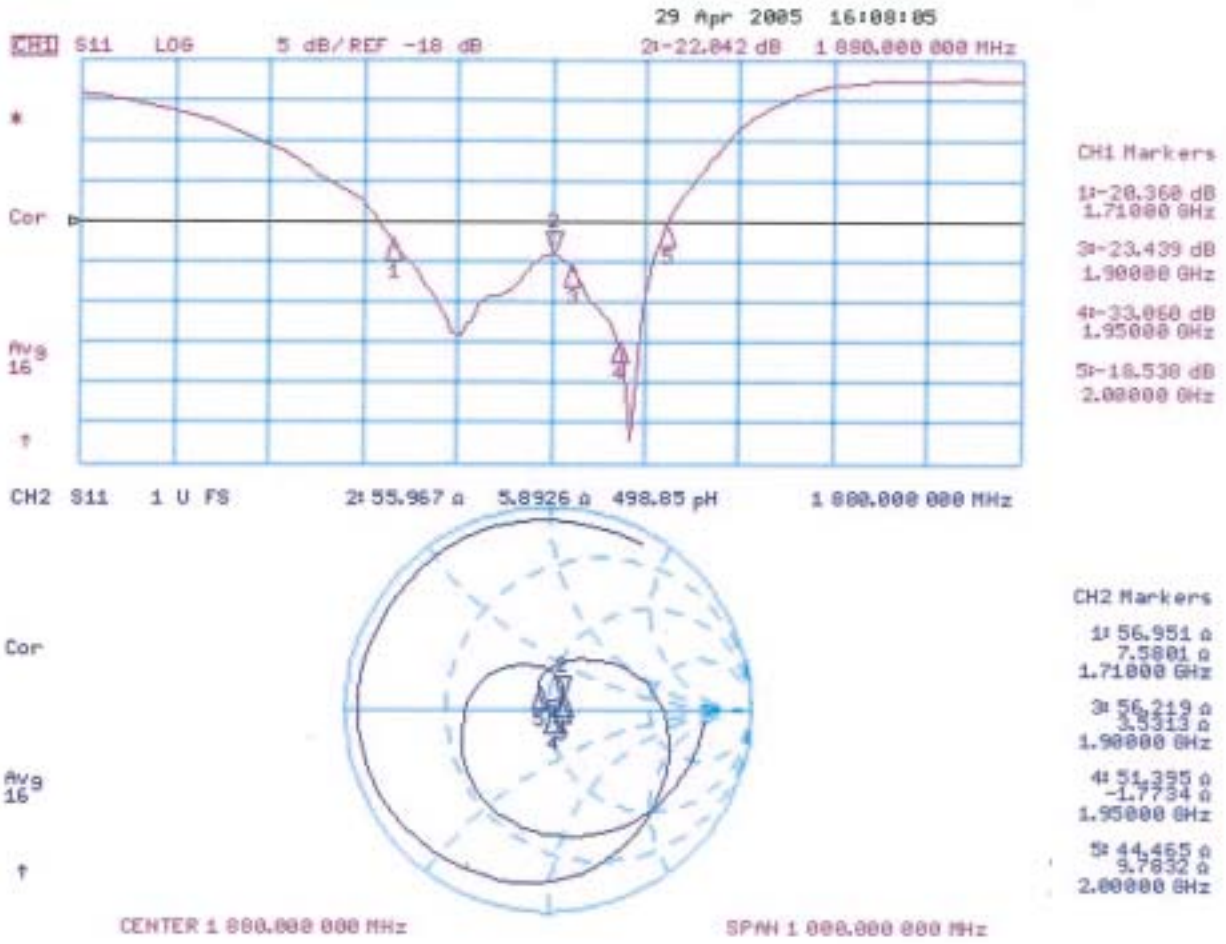
3.2 Antenna Design and Handling

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 DASY4 H-field result

Date/Time: 05.04.2005 15:42:58

Test Laboratory: IT'IS

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1016

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

DASY4 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 10.12.2004
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn901; Calibrated: 29.06.2004
- Phantom: HAC Phantom; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

H Scan 10mm above CD 1880 MHz/Hearing Aid Compatibility Test (41x181x1):

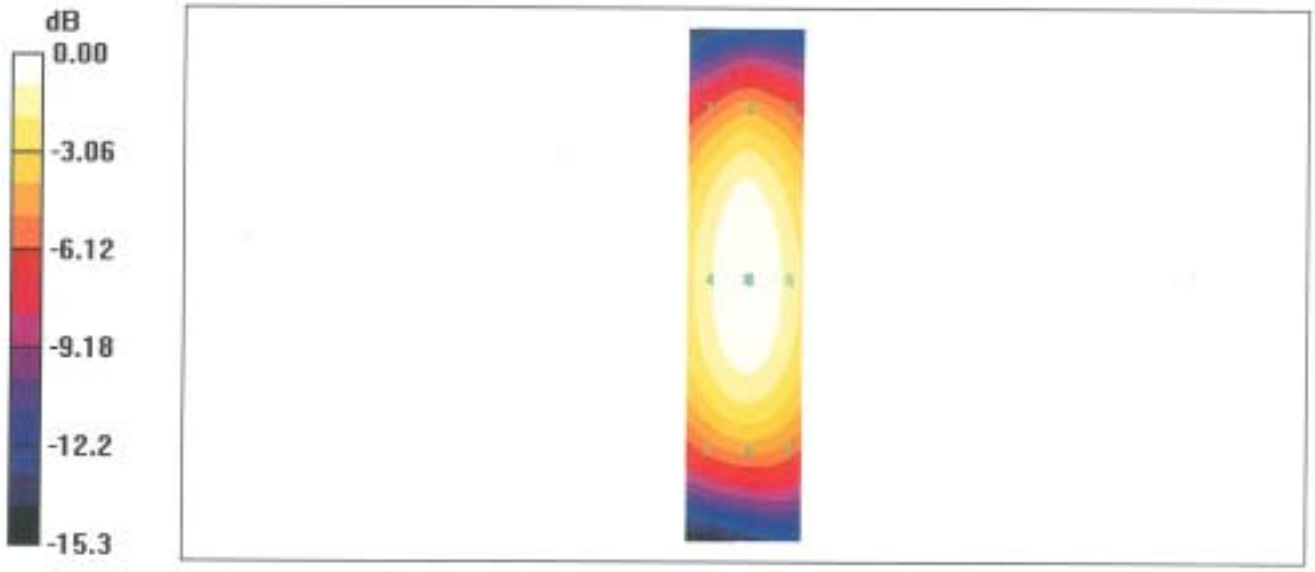
Measurement grid: dx=5mm, dy=5mm
Maximum value of Total field (slot averaged) = 0.457 A/m
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

H in A/m (Time averaged)

Grid 1 **0.396**	Grid 2 **0.427**	Grid 3 **0.406**
Grid 4 **0.428**	Grid 5 **0.457**	Grid 6 **0.440**
Grid 7 **0.385**	Grid 8 **0.411**	Grid 9 **0.397**

H in A/m (Slot averaged)

Grid 1 **0.396**	Grid 2 **0.427**	Grid 3 **0.406**
Grid 4 **0.428**	Grid 5 **0.457**	Grid 6 **0.440**
Grid 7 **0.385**	Grid 8 **0.411**	Grid 9 **0.397**



0 dB = 0.457A/m

3.3.3 DASY4 E-Field result

Date/Time: 05.04.2005 10:48:21

Test Laboratory: IT'IS

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1016

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
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 20.01.2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn901; Calibrated: 29.06.2004
- Phantom: HAC Phantom; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

E Scan 10mm above CD 1880 MHz/Hearing Aid Compatibility Test (41x181x1):

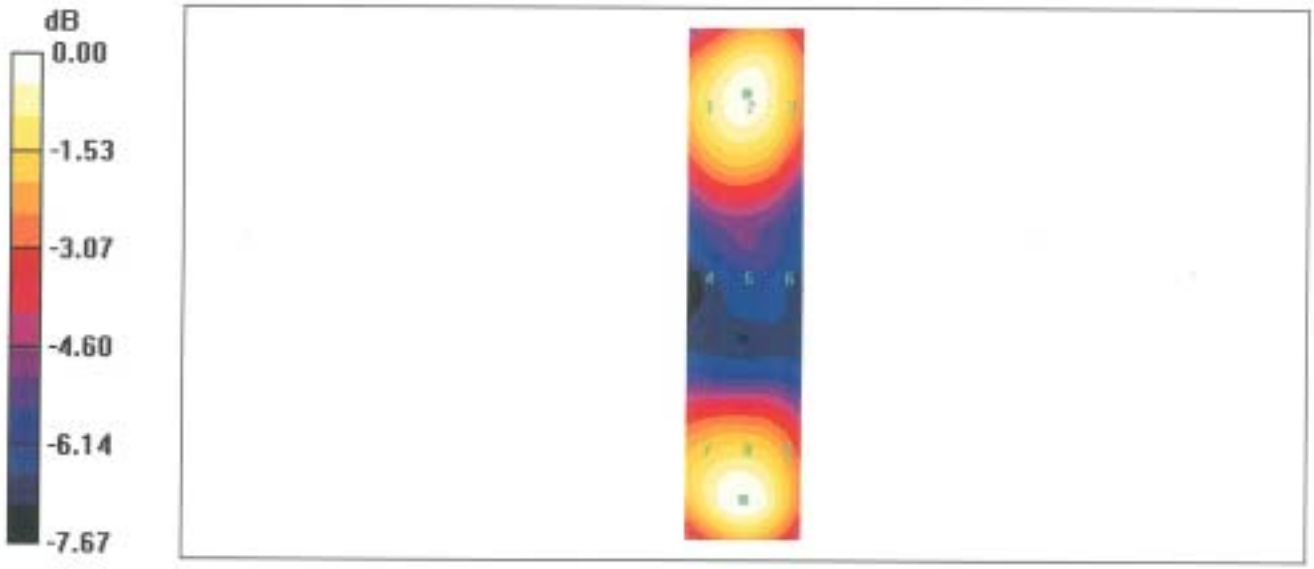
Measurement grid: dx=5mm, dy=5mm
Maximum value of Total field (slot averaged) = 139.9 V/m
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

E in V/m (Time averaged)

Grid 1 **132.2**	Grid 2 **137.2**	Grid 3 **132.8**
Grid 4 **89.8**	Grid 5 **91.0**	Grid 6 **87.3**
Grid 7 **133.9**	Grid 8 **139.9**	Grid 9 **134.7**

E in V/m (Slot averaged)

Grid 1 **132.2**	Grid 2 **137.2**	Grid 3 **132.8**
Grid 4 **89.8**	Grid 5 **91.0**	Grid 6 **87.3**
Grid 7 **133.9**	Grid 8 **139.9**	Grid 9 **134.7**



0 dB = 139.9V/m