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Regulatory Compliance Group
IT R&D Center

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Gyeonggi-do, Korea 443-742

TEST REPORT ON HAC

Model Tested:	**SPH-M310**
FCC ID (Requested) :	**A3LSPHM310**
Job No :	**AE-070**
Report No :	**AE-070-M1**
Date issued :	**Jan. 10, 2008**
Result Summary :	**M4 (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

Prepared By ______________________
YB KIM – Test Engineer

Authorized By ______________________
JH NAM – Technical Manager

Contents

1. GENERAL INFORMATION

Test Sample :	Single-Band PCS Phone with Bluetooth
Model Number :	SPH-M310
Serial Number :	Identical prototype (S/N : # AE-070-E)
Manufacturer :	SAMSUNG ELECTRONICS Co., Ltd.
Contact :	JH Choi
Phone :	+82-31-301-7960
Fax :	+82-31-279-7610
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 :	Jan.07,2008
Tested for :	FCC/TCB Certification

2. DESCRIPTION OF DEVICE

Tx Freq. Range :	1851.25 ~ 1908.76 MHz(PCS)
Rx Freq. Range :	1931.25 ~ 1988.76 MHz(PCS)
Antenna Configuration :	DISPHM310PA
Antenna Manufacturer :	Partron
Antenna Dmimensions :	34.87mm × 7.63mm × 3.7mm

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 (Staubli), 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).

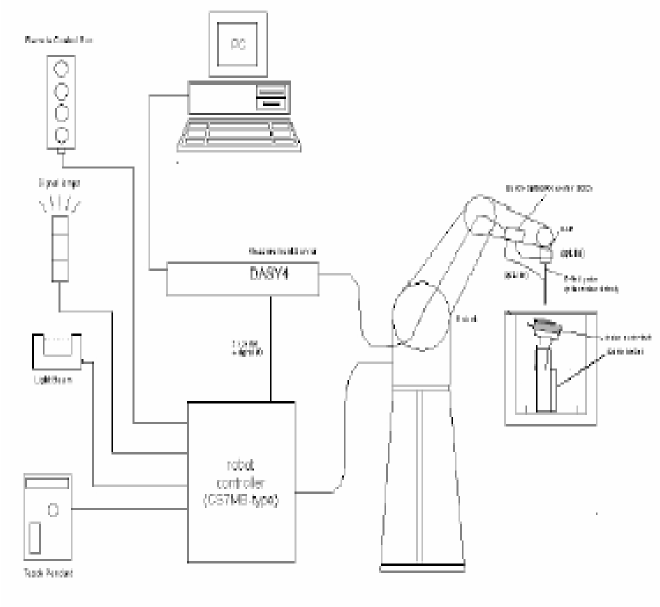


Figure 3.1 HAC Measurement System Setup

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 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 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/mto2A/mat1 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

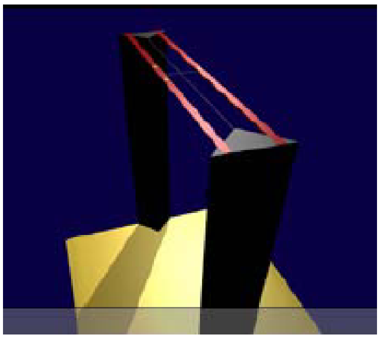


Figure 3.4 Test Arch Phantom

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 - Validaation 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

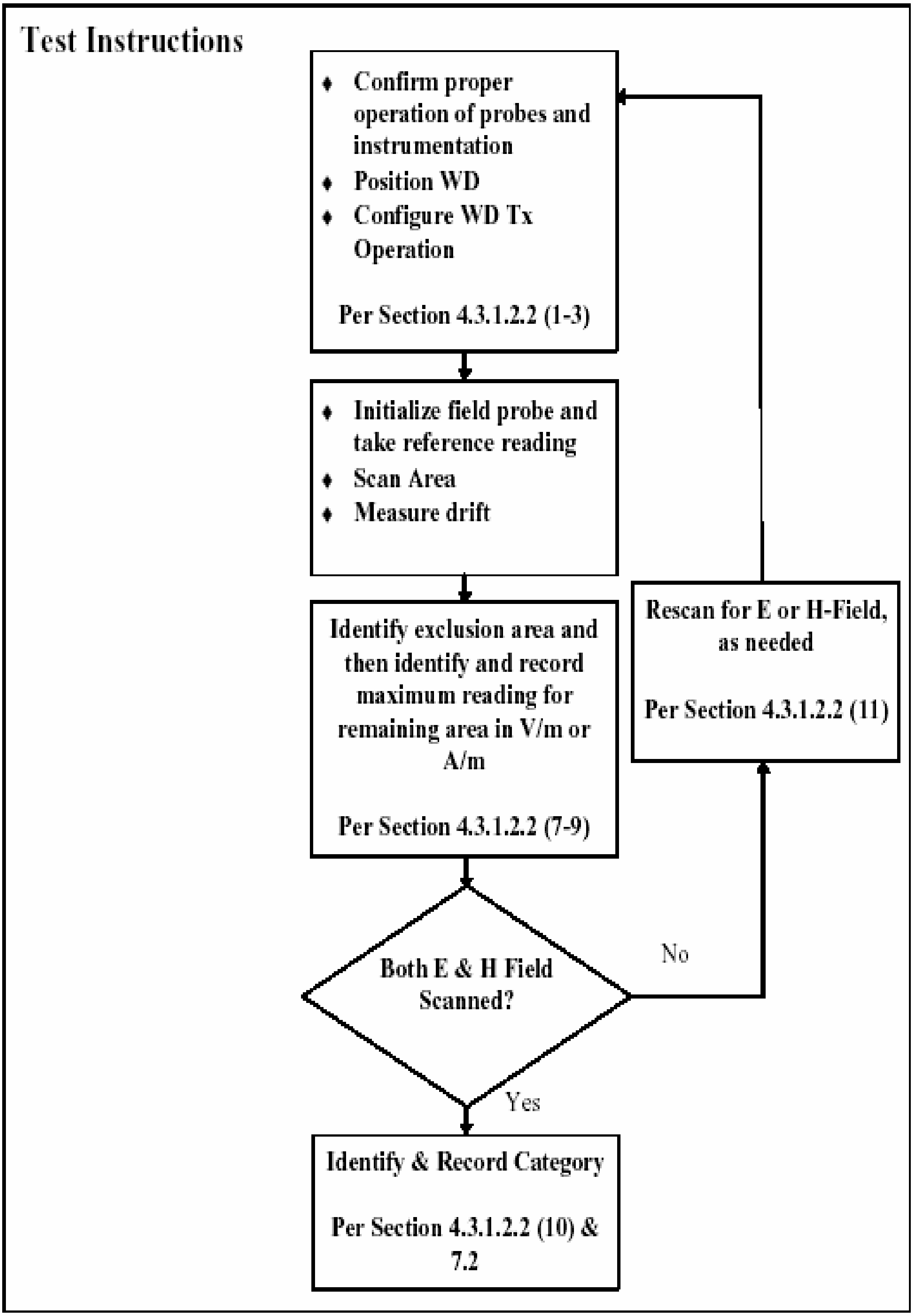
Table 3.2 Test Equipment Calibration

Type	Calibration Due Date	Serial No.
Stäubli Robot RX90BL	Not Required	F05/51G6A1/A/01
HAC Phantom	Not Required	1018
SPEAG DAE3 V2	2008.08.30	468
SPEAG E-Field Probe ER3DV6	2008.04.20	2370
SPEAG H-Field Probe H3DV6	2008.04.20	6197
SPEAG Validation Dipole CD1880 V3	2009.02.12	1074
E4438C Signal Generator	2008.03.21	MY45092224
BBS3Q7ECK Power Amp	2008.01.22	1023
E4419B Power Meter	2008.05.10	MY45101764
E9300B Power Sensor	2008.04.27	MY52505880
DASY4 S/W (ver 4.7)	Not Required	-
Directional Coupler	2008.05.31	18862
Spectrum Analyzer	2008.02.05	MY46186167
Base Station Simulator	2008.06.20	GB45360270

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. A 360° rotation about the azimuth axis at the maximum interpolated position was measured. For the worst-case condition, the peak reading from this rotation was used in re-evaluating the HAC category.

8. The system performed a drift evaluation by measuring the field at the reference location.

9. Steps 1-8 were done for both the E and H-Field measurements.

10. The HAC measurement software calculates a reference point at the start and end of the test to check fo power drifts. If conducted power deviations of more than 5% occurred, the tests were repeated.

5. DESCRIPTION OF TEST POSITION

5.1 Measurement reference and plane

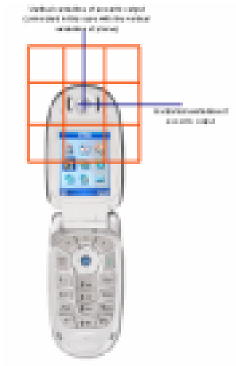


Figure 5.1 Wireless Device and Measurement Plane

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.

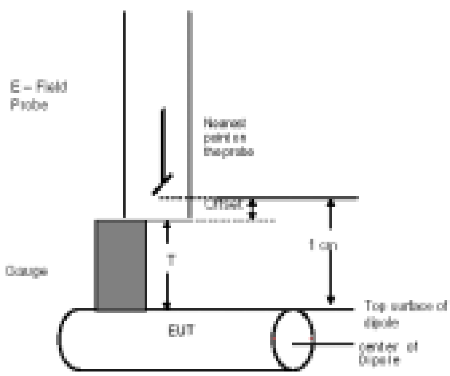


Figure 5.2 Gauge block with E-field probe

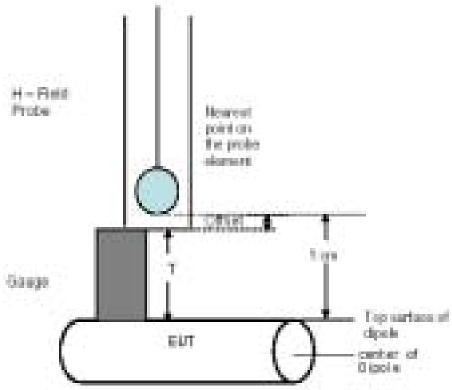


Figure 5.3 Gauge block with H-field probe

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 C, 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
1880 MHz	135.45	143.35	5.83	0.454	0.453	-0.22	Jan.7, 2008

*Validation was measured with input power 100 mW

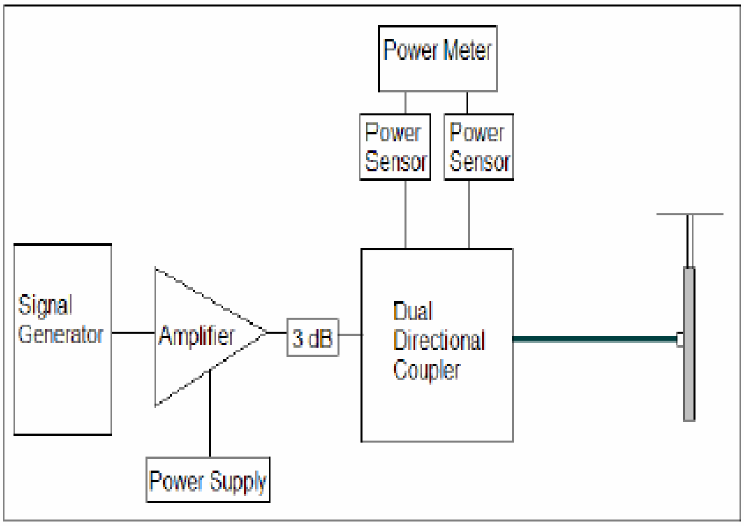


Figure 7.1 Dipole Validation Test Setup

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.

6. The ratio of the CW reading to modulated signal reading is the probe modulation factor(PMF) for the modulation and field probe combination. This was repeated for 80% AM.

7. Steps 1-6 were repeated at all frequency bands and for both E and H field probes.

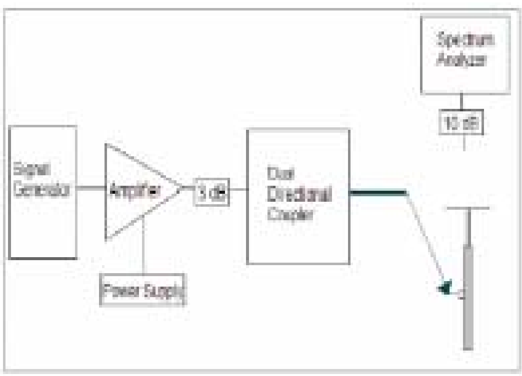


Figure 8.1 Setup to Dipole

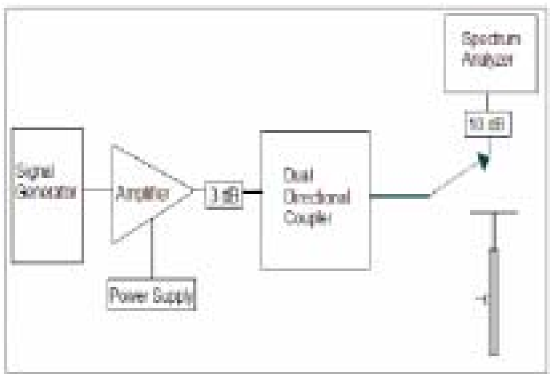


Figure 8.2 Setup to Peak Power using Spectrum Analyzer

8.1 Modulation Factors

Frequency	Protocol	E-field (V/m)	H-field (A/m)	E-Field PMF	H-Field PMF
1880 MHz	AM	28.5	0.087	1.56	1.56
1880MHz	CDMA	44.4	0.139	1.00	0.98
1880 MHz	CW	44.4	0.136	-	-
1880 MHz	RC1/SO3	22.7	0.100	2.72	2.74
1880 MHz	CW	61.8	0.2	-	-

Table 8.1 Modulation Factors

8.2 CW and Modulated Signal Zero-span plots:

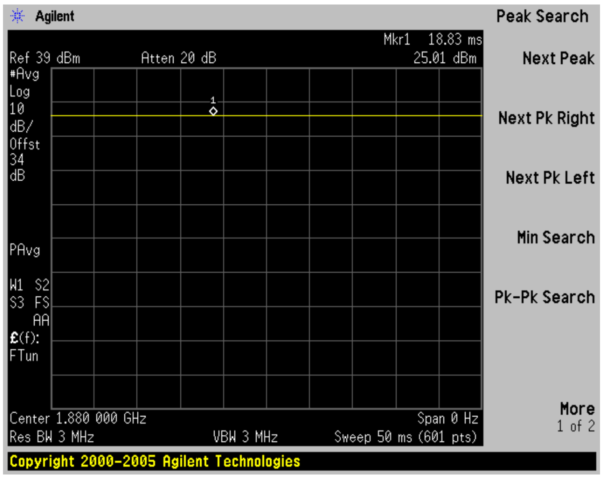


Figure 8.3 CW Signal

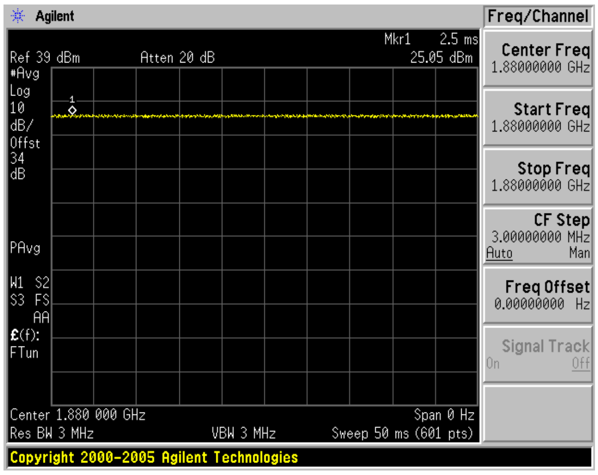


Figure 8.4 CDMA Signal

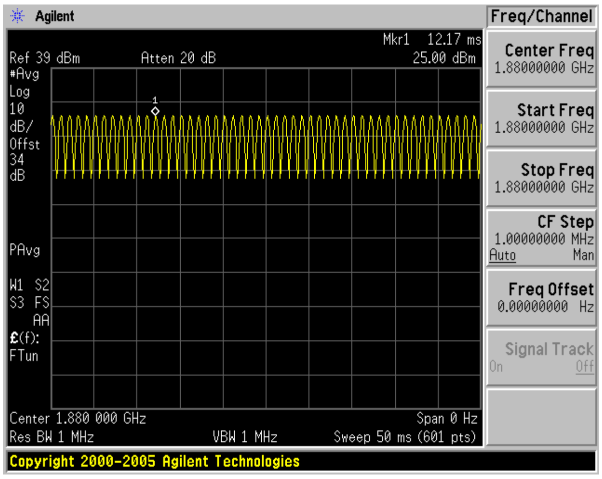


Figure 8.5 AM 80% Signal

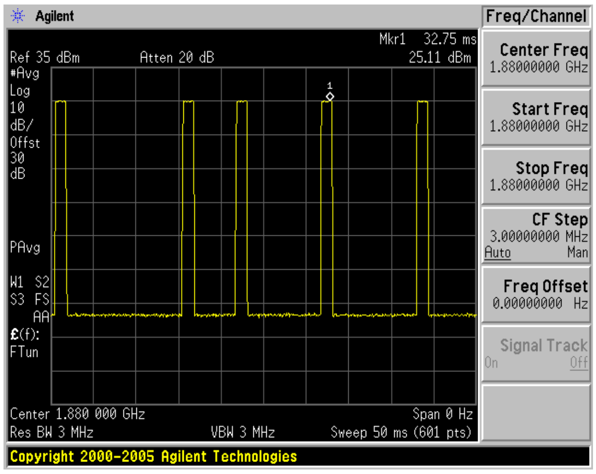


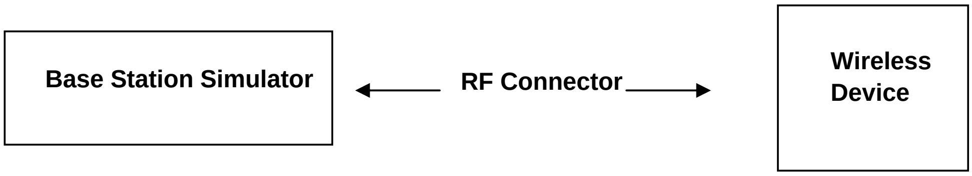
Figure 8.6 1/8 rate Signal

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	Antenna	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 -Slide Up												
PCS	600	off	RC3/SO55	Standard	Intenna	24.9	43.9	43.93	32.86	M4	41.0	-8.14
PCS	600	on	RC3/SO55	Standard	Intenna	24.9	43.8	43.78	32.83	M4	41.0	-8.17
PCS	600	off	RC1/SO2	Standard	Intenna	24.9	43.7	43.66	32.80	M4	41.0	-8.20
PCS	600	off	RC3/SO2	Standard	Intenna	25.0	44.0	44.02	32.87	M4	41.0	-8.13
PCS	600	off	RC1/SO55	Standard	Intenna	24.9	43.2	43.16	32.70	M4	41.0	-8.30
PCS	600	off	RC2/SO9	Standard	Intenna	24.9	43.3	43.28	32.73	M4	41.0	-8.27
PCS	600	off	RC1/SO3	Standard	Intenna	25.0	16.1	43.82	32.83	M4	41.0	-8.17
PCS	600	off	RC3/SO3	Standard	Intenna	25.0	43.6	43.55	32.78	M4	41.0	-8.22
PCS	600	off	RC2/SO17	Standard	Intenna	24.9	16.1	43.85	32.84	M4	41.0	-8.16

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

10. Test Results

10.1 Measurement Results(E-field) - Slide-Up

E-FIELD EMISSIONS:

Mode	Channel	Back light	RC/SO	Battery	Antenna	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]	Excl Blocks Per 4.3.1.2.2
E-field Emissions													
PCS	25	off	RC1/SO2	Standard	Intenna	25.2	40.7	40.7	32.19	M4	41.0	-8.81	None
PCS	600	off	RC3/SO2	Standard	Intenna	25.0	46.1	46.1	33.27	M4	41.0	-7.73	None
PCS	1175	off	RC3/SO2	Standard	Intenna	24.9	40.2	40.2	32.08	M4	41.0	-8.92	None
PCS	600	on	RC3/SO2	Standard	Intenna	25.0	43.8	43.8	32.83	M4	41.0	-8.17	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) - Slide-Up

H-FIELD EMISSIONS:

Mode	Channel	Back light	RC/SO	Battery	Antenna	Conducted Power at BS(dBm)	Time Avg. Field [A/m]	Peak Field [A/m]	Peak Field [dBA/m]	Category	FCC limit [dBA/m]	FCC Margin [dB]	Excl Blocks Per 4.3.1.2.2
H-field Emissions													
PCS	25	off	RC3/SO2	Standard	Intenna	25.2	0.138	0.135	-17.39	M4	-9.4	-7.99	None
PCS	600	off	RC3/SO2	Standard	Intenna	25.0	0.126	0.123	-18.20	M4	-9.4	-8.80	None
PCS	1175	off	RC3/SO2	Standard	Intenna	24.9	0.111	0.109	-19.25	M4	-9.4	-9.85	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)

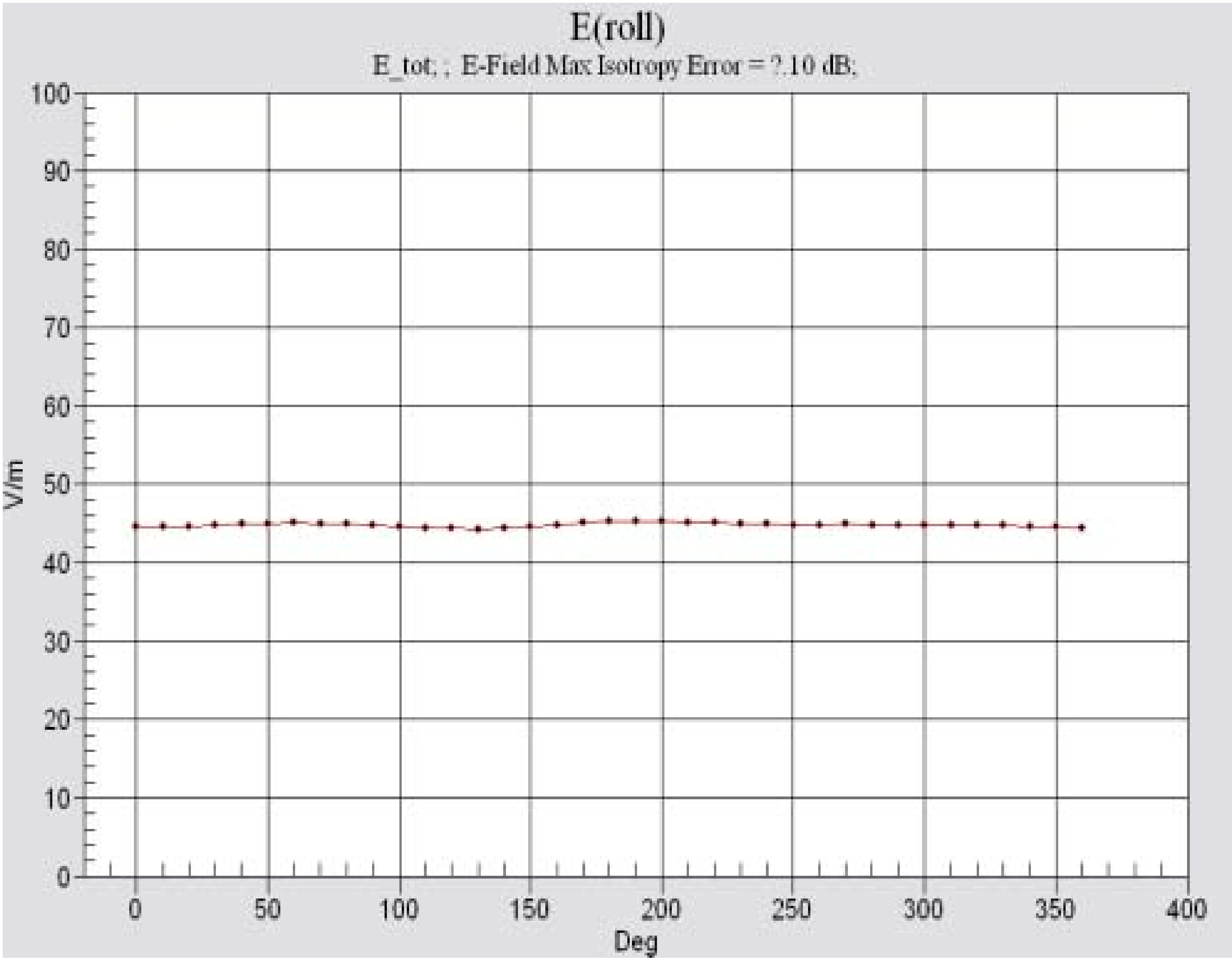
Note: Worst-case measurement evaluated for worst-case 1/8 rate gating condition in RC1/SO3; Mute=Yes

10.3 Worst-case Configuration Evaluation

PCS E-field Emission - Slide Up

Mode	Channel	Back light	RC/SO	Battery	Antenna	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 Emission												
PCS	600	off	RC3/SO2	Standard	Intenna	25.0	45.4	45.36	33.13	M4	41.0	-7.87

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

11. REFERENCES

[1] ANSI C63.19-2006, American National Standard for Methods of Measurement of Compatibility between Wireless communication devices and Hearing Aids.", New York,NY, IEEE, April 2005.

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SAMSUNG

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 ı 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	AM80%
RBW	Same setting with modulated signal respectively.	1MHz	3MHz	5MHz	1MHz
VBW		1MHz	3MHz	5MHz	1MHz
SPAN		0MHz	0MHz	0MHz	0MHz
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 C

The Validation Measurements

DUT: HAC Dipole 1880 MHz; Serial: SN:1074
Program Name: HAC E Dipole E-Field, Date : Jan/07/2008
Procedure Name: E Scan 10mm above CD 1880 MHz

Communication System: CW; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: E Dipole Section

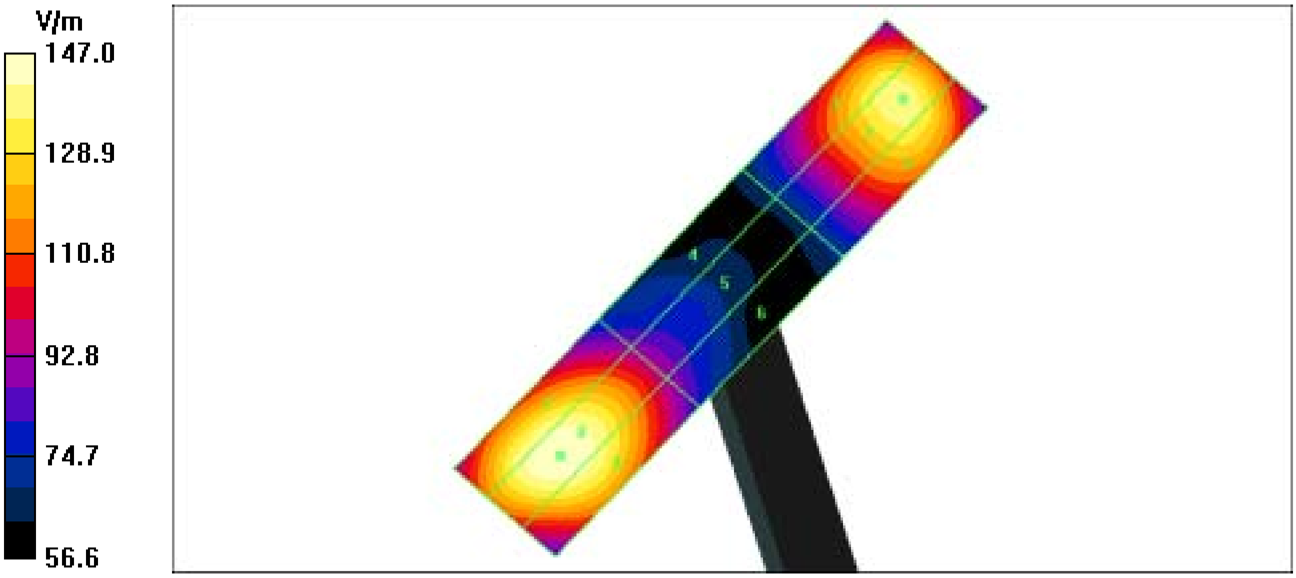
DASY4 Configuration:
- Probe: ER3DV6 - SN2370; ConvF(1, 1, 1); Calibrated: 2007-04-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn468; Calibrated: 2007-08-30
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

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

Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 147.0 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 354.7 mm
Reference Value = 153.2 V/m; Power Drift = -0.017 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **135.8 M2**	Grid 2 **139.7 M2**	Grid 3 **135.2 M2**
Grid 4 **90.5 M3**	Grid 5 **95.3 M3**	Grid 6 **93.2 M3**
Grid 7 **142.0 M2**	Grid 8 **147.0 M2**	Grid 9 **142.3 M2**



DUT: HAC Dipole 1880 MHz; Serial: SN:1074
Program Name: HAC H Dipole H-Field, Date : Jan/07/2008
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

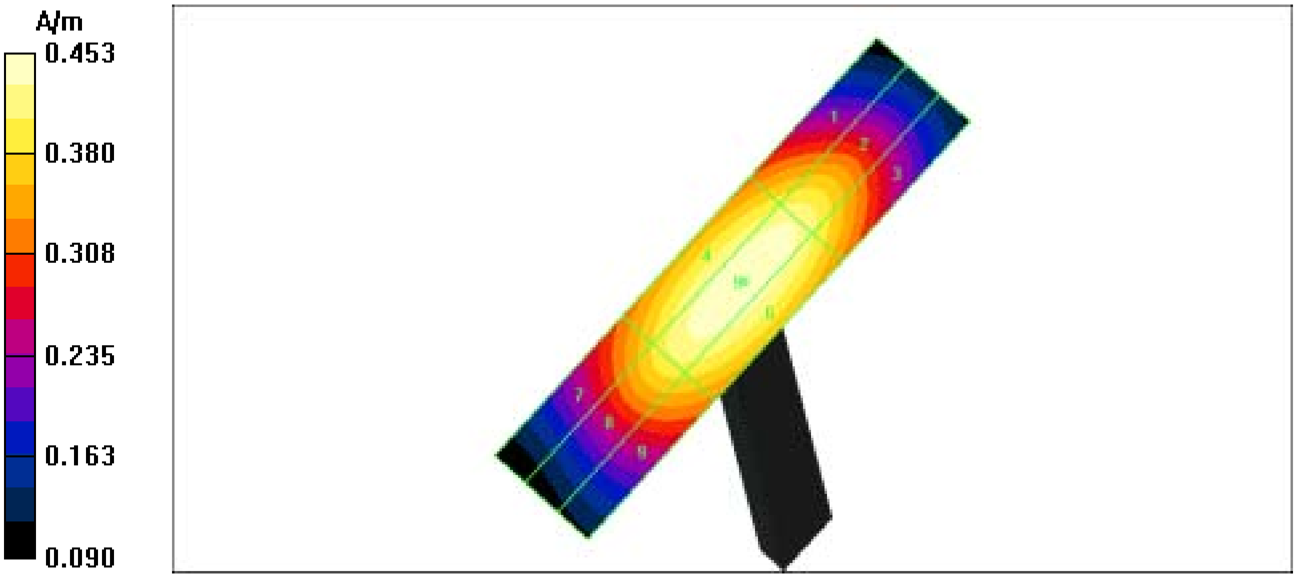
DASY4 Configuration:
- Probe: H3DV6 - SN6197; ; Calibrated: 2007-04-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn468; Calibrated: 2007-08-30
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

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

Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.453 A/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 354.7 mm
Reference Value = 0.452 A/m; Power Drift = -0.021 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.397 M2**	Grid 2 **0.424 M2**	Grid 3 **0.408 M2**
Grid 4 **0.429 M2**	Grid 5 **0.453 M2**	Grid 6 **0.437 M2**
Grid 7 **0.381 M2**	Grid 8 **0.402 M2**	Grid 9 **0.389 M2**



APPENDIX D

Plots of The HAC Measurements

DUT: SPH-M310(Up); Serial: AE-070-E
Program Name: SPH-M310(PCS) E-Field,Slide Up (Date: Jan/07/2008)
Procedure Name: Ch.25, Ant, Intenna, Bat.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

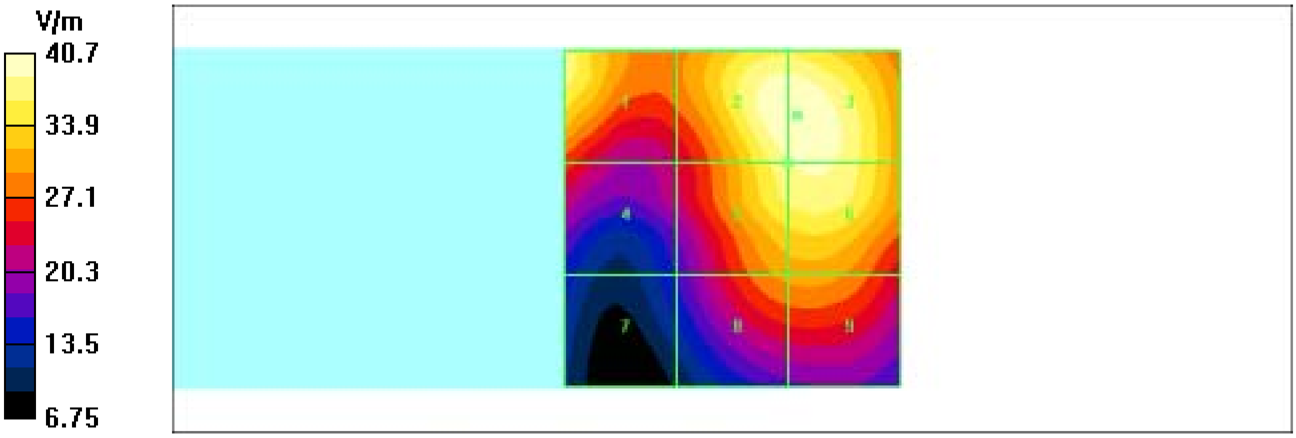
DASY4 Configuration:
- Probe: ER3DV6 - SN2370; ConvF(1, 1, 1); Calibrated: 2007-04-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn468; Calibrated: 2007-08-30
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Ch.25, Ant, Intenna, Bat.Standard/Hearing Aid Compatibility Test (251x251x1):

Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 40.7 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 31.3 V/m; Power Drift = -0.134 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **37.9 M4**	Grid 2 **40.7 M4**	Grid 3 **40.7 M4**
Grid 4 **26.4 M4**	Grid 5 **38.3 M4**	Grid 6 **39.1 M4**
Grid 7 **16.1 M4**	Grid 8 **30.2 M4**	Grid 9 **30.5 M4**



DUT: SPH-M310(Up); Serial: AE-070-E
Program Name: SPH-M310(PCS) E-Field,Slide Up (Date: Jan/07/2008)
Procedure Name: Ch.600, Ant, Intenna, Bat.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

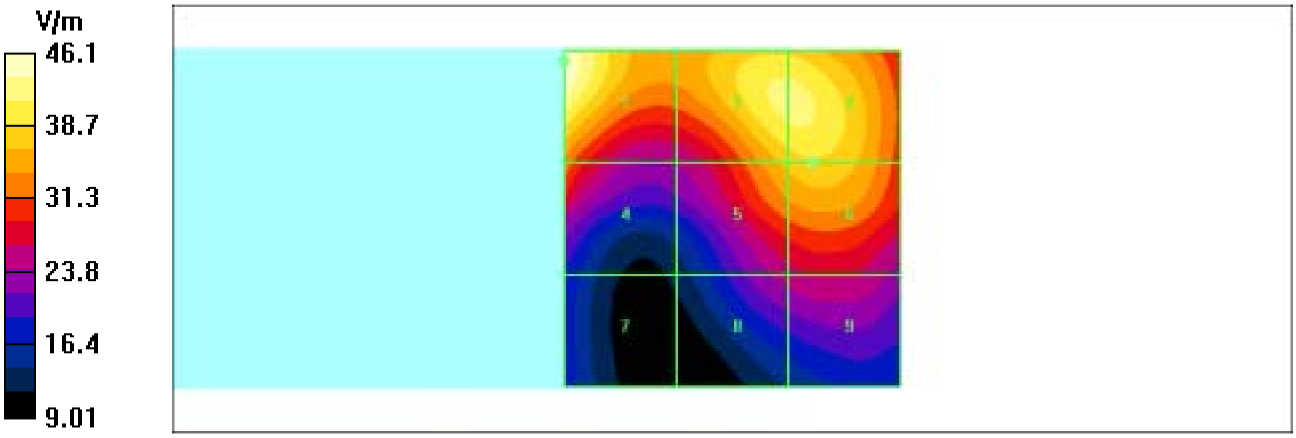
DASY4 Configuration:
- Probe: ER3DV6 - SN2370; ConvF(1, 1, 1); Calibrated: 2007-04-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn468; Calibrated: 2007-08-30
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Ch.600, Ant, Intenna, Bat.Standard/Hearing Aid Compatibility Test (251x251x1):

Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 46.1 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 27.8 V/m; Power Drift = 0.041 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **46.1 M4**	Grid 2 **42.0 M4**	Grid 3 **42.0 M4**
Grid 4 **33.4 M4**	Grid 5 **37.2 M4**	Grid 6 **38.3 M4**
Grid 7 **18.7 M4**	Grid 8 **25.3 M4**	Grid 9 **26.6 M4**



DUT: SPH-M310(Up); Serial: AE-070-E
Program Name: SPH-M310(PCS) E-Field,Slide Up (Date: Jan/07/2008)
Procedure Name: Ch.1175, Ant, Intenna, Battery standard

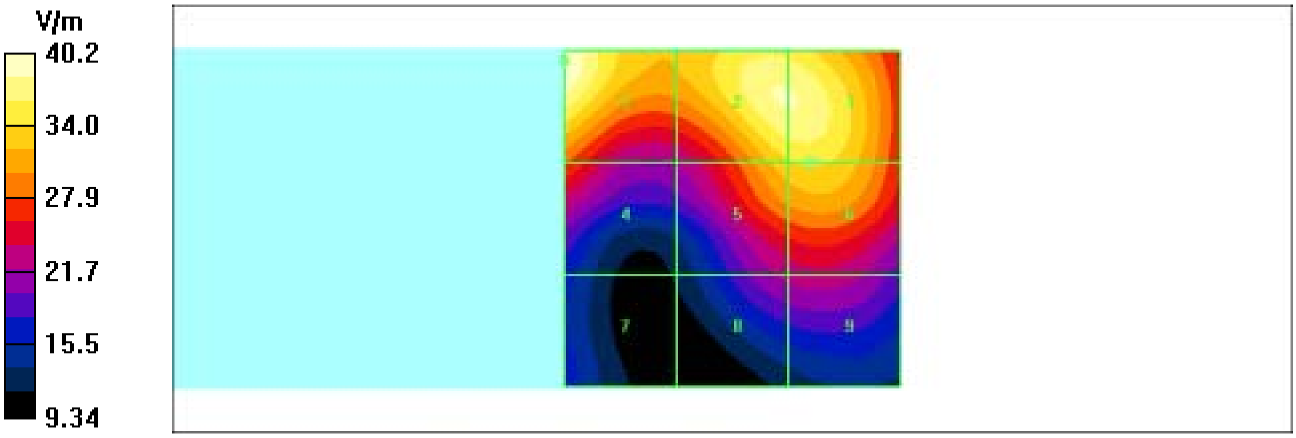
Communication System: PCS; Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Device Section

DASY4 Configuration:
- Probe: ER3DV6 - SN2370; ConvF(1, 1, 1); Calibrated: 2007-04-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn468; Calibrated: 2007-08-30
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Ch.1175, Ant, Intenna, Battery standard/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 40.2 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 24.1 V/m; Power Drift = -0.003 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **40.2 M4**	Grid 2 **38.3 M4**	Grid 3 **38.3 M4**
Grid 4 **28.0 M4**	Grid 5 **33.7 M4**	Grid 6 **34.5 M4**
Grid 7 **17.0 M4**	Grid 8 **22.5 M4**	Grid 9 **23.2 M4**



DUT: SPH-M310(Up); Serial: AE-070-E
Program Name: SPH-M310(PCS) H-Field,Slide Up (Date: Jan/07/2008)
Procedure Name: Ch.25, Ant. Intenna, Bat.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: H Device Section

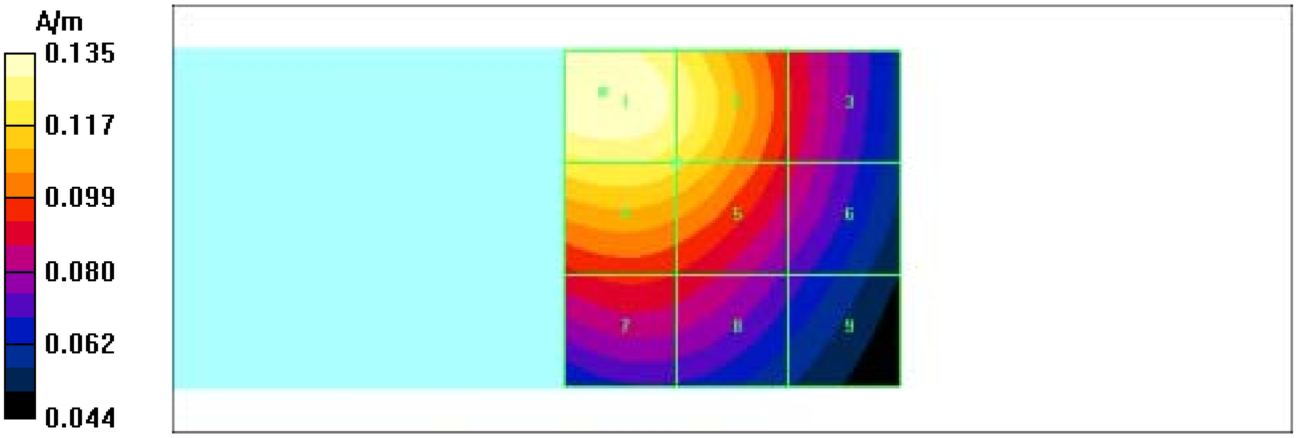
DASY4 Configuration:
- Probe: H3DV6 - SN6197; ; Calibrated: 2007-04-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn468; Calibrated: 2007-08-30
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Ch.25, Ant. Intenna, Bat.Standard/Hearing Aid Compatibility Test (251x251x1):

Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 0.135 A/m
Probe Modulation Factor = 0.980
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 0.101 A/m; Power Drift = -0.085 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.135 M4**	Grid 2 **0.128 M4**	Grid 3 **0.094 M4**
Grid 4 **0.123 M4**	Grid 5 **0.119 M4**	Grid 6 **0.089 M4**
Grid 7 **0.095 M4**	Grid 8 **0.092 M4**	Grid 9 **0.073 M4**



DUT: SPH-M310(Up); Serial: AE-070-E
Program Name: SPH-M310(PCS) H-Field,Slide Up (Date: Jan/07/2008)
Procedure Name: Ch.0600, Ant. Intenna, Bat.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: H Device Section

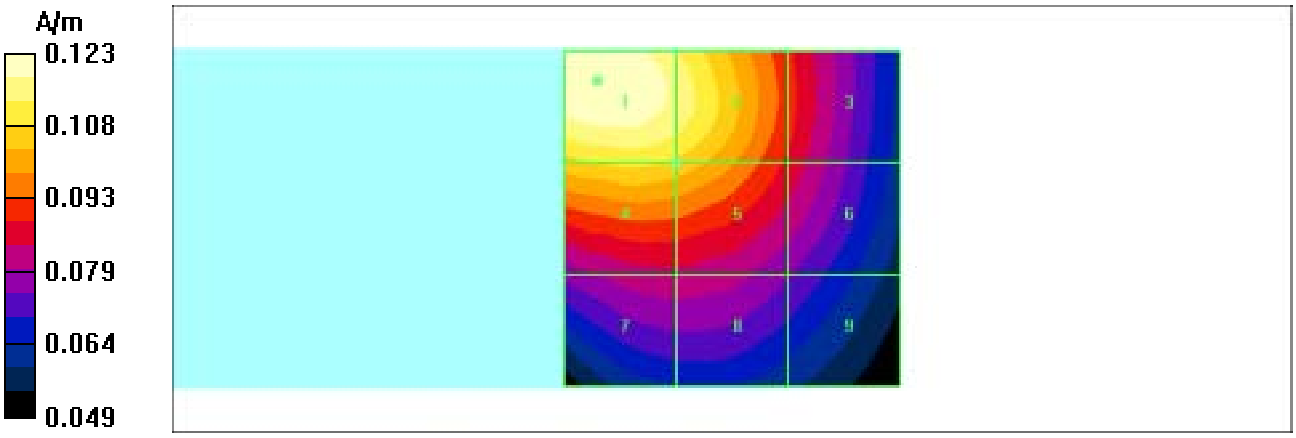
DASY4 Configuration:
- Probe: H3DV6 - SN6197; ; Calibrated: 2007-04-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn468; Calibrated: 2007-08-30
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Ch.0600, Ant. Intenna, Bat.Standard/Hearing Aid Compatibility Test (251x251x1):

Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 0.123 A/m
Probe Modulation Factor = 0.980
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 0.093 A/m; Power Drift = -0.149 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.123 M4**	Grid 2 **0.117 M4**	Grid 3 **0.091 M4**
Grid 4 **0.110 M4**	Grid 5 **0.107 M4**	Grid 6 **0.087 M4**
Grid 7 **0.082 M4**	Grid 8 **0.082 M4**	Grid 9 **0.074 M4**



DUT: SPH-M310(Up); Serial: AE-070-E
Program Name: SPH-M310(PCS) H-Field,Slide Up (Date: Jan/07/2008)
Procedure Name: Ch.1175, Ant. Intenna, Bat.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: H Device Section

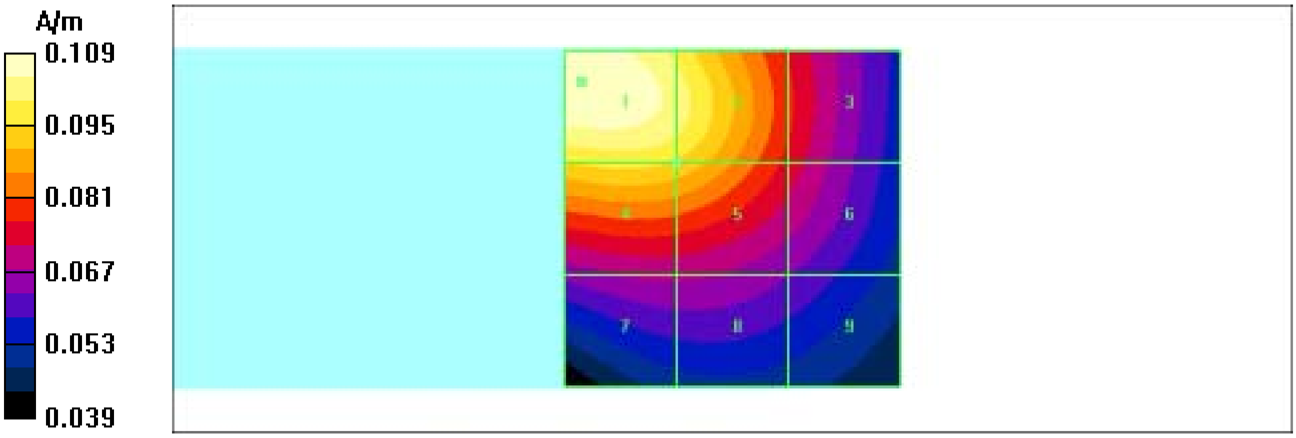
DASY4 Configuration:
- Probe: H3DV6 - SN6197; ; Calibrated: 2007-04-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn468; Calibrated: 2007-08-30
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Ch.1175, Ant. Intenna, Bat.Standard/Hearing Aid Compatibility Test (251x251x1):

Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 0.109 A/m
Probe Modulation Factor = 0.980
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 0.079 A/m; Power Drift = -0.005 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.109 M4**	Grid 2 **0.102 M4**	Grid 3 **0.078 M4**
Grid 4 **0.097 M4**	Grid 5 **0.094 M4**	Grid 6 **0.075 M4**
Grid 7 **0.068 M4**	Grid 8 **0.068 M4**	Grid 9 **0.063 M4**



DUT: SPH-M310(Up); Serial: AE-070-E
Program Name: SPH-M310(PCS) E-Field,Slide Up (Date: Jan/07/2008)
Procedure Name: Ch.600, Ant, Intenna, Bat.Standard BL ON

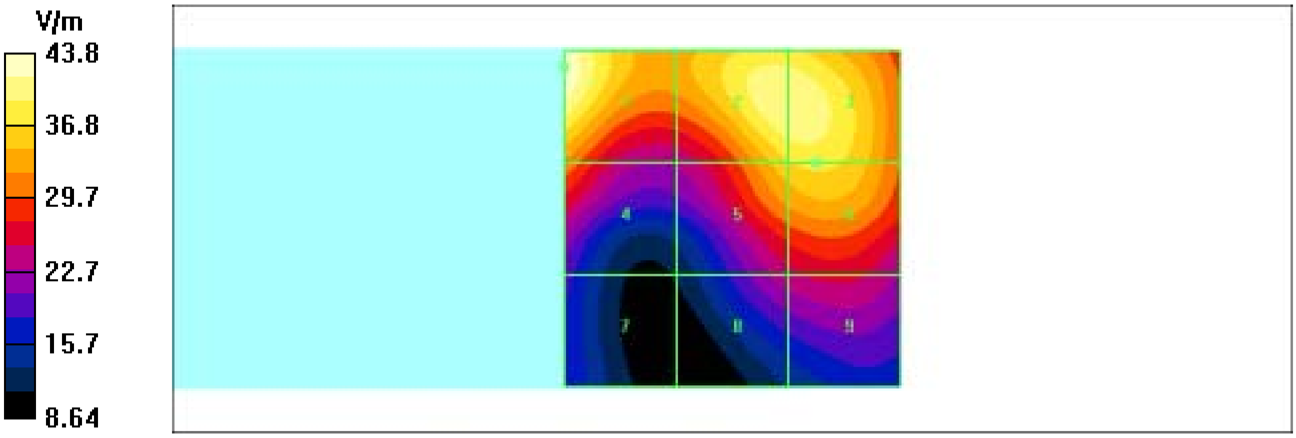
Communication System: PCS; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Device Section

DASY4 Configuration:
- Probe: ER3DV6 - SN2370; ConvF(1, 1, 1); Calibrated: 2007-04-20
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn468; Calibrated: 2007-08-30
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1018
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Ch.600, Ant, Intenna, Bat.Standard BL ON/Hearing Aid Compatibility Test (251x251x1): Measurement grid: dx=2mm, dy=2mm
Maximum value of peak Total field = 43.8 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 353.7 mm
Reference Value = 25.7 V/m; Power Drift = -0.061 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **43.8 M4**	Grid 2 **41.2 M4**	Grid 3 **41.2 M4**
Grid 4 **31.8 M4**	Grid 5 **36.6 M4**	Grid 6 **37.6 M4**
Grid 7 **19.2 M4**	Grid 8 **24.3 M4**	Grid 9 **25.9 M4**



APPENDIX E

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 C (Dymstec)**

Certificate No: **ER3-2370_Apr07**

CALIBRATION CERTIFICATE

Object	ER3DV6 - SN:2370
Calibration procedure(s)	QA CAL-02.v5 Calibration procedure for E-field probes optimized for close near field evaluations in air
Calibration date:	April 20, 2007
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41495277	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41498087	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-06 (METAS, No. 217-00592)	Aug-07
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-07 (METAS, No. 217-00671)	Mar-08
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-06 (METAS, No. 217-00593)	Aug-07
Reference Probe ER3DV6	SN: 2328	2-Oct-06 (SPEAG, No. ER3-2328_Oct06)	Oct-07
DAE4	SN: 907	20-Jul-06 (SPEAG, No. DAE4-907_Jul06)	Jul-07
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	i. V. F. Bomholt

Issued: April 21, 2007

OK to use.
2007. 5. 16

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 for XY sensors and ϑ = 90 for Z sensor ($f \leq 900$ 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:2370

Manufactured:	October 12, 2005
Last calibrated:	May 16, 2006
Recalibrated:	April 20, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ER3DV6 SN:2370

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

NormX	**1.74** ± 10.1 % (k=2)
NormY	**1.62** ± 10.1 % (k=2)
NormZ	**1.96** ± 10.1 % (k=2)

Diode Compression[A]

DCP X	**95** mV
DCP Y	**95** mV
DCP Z	**98** 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

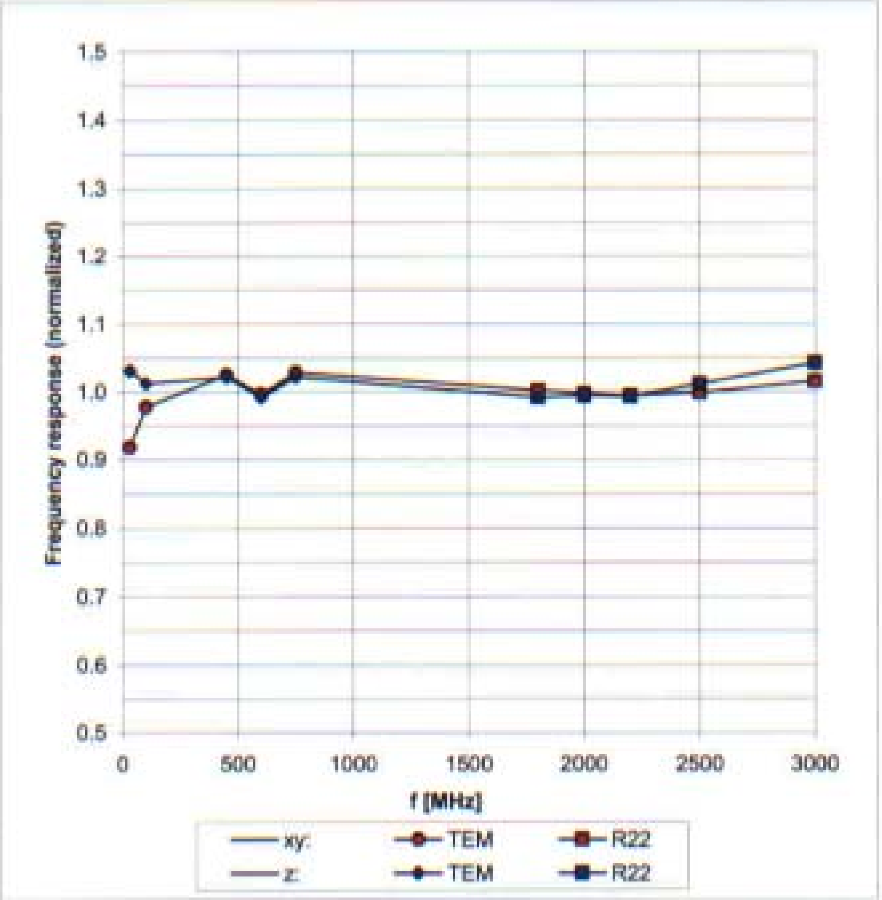
Connector Angle **-45** °

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

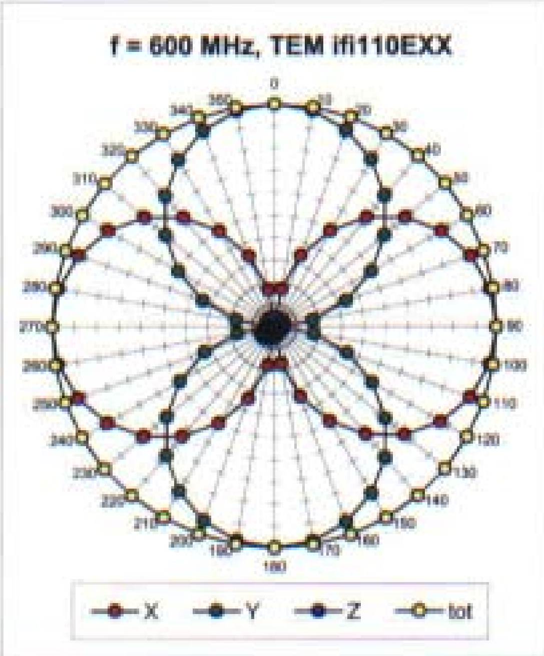
Frequency Response of E-Field

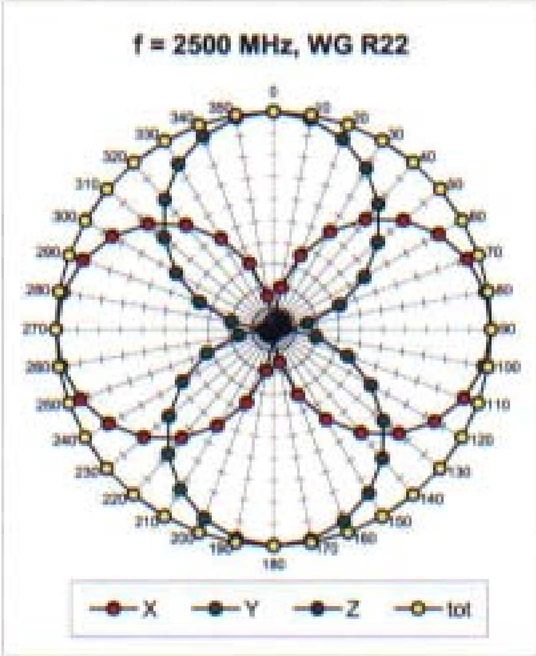
(TEM-Cell:ifi110 EXX, Waveguide R22)



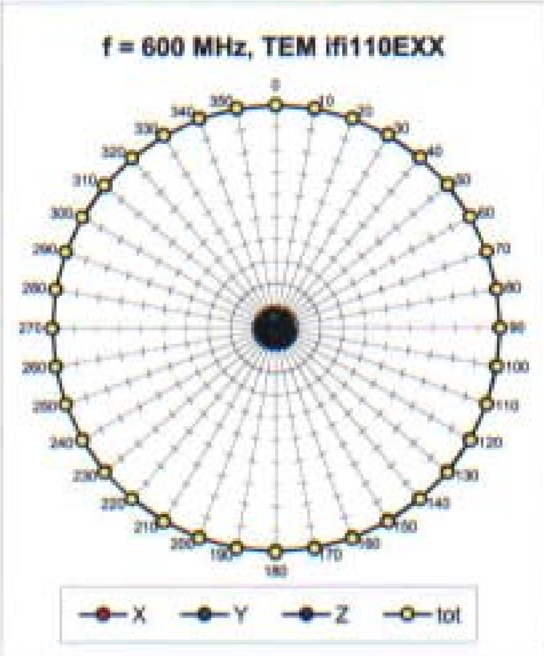
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

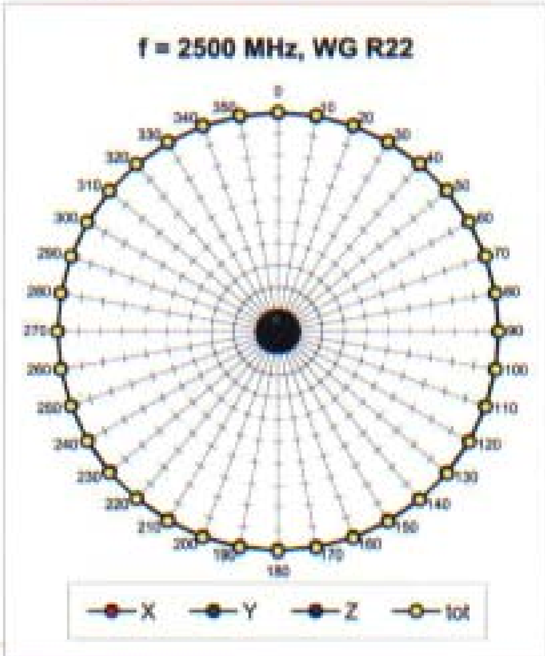
Receiving Pattern (ϕ), $\vartheta = 0°$



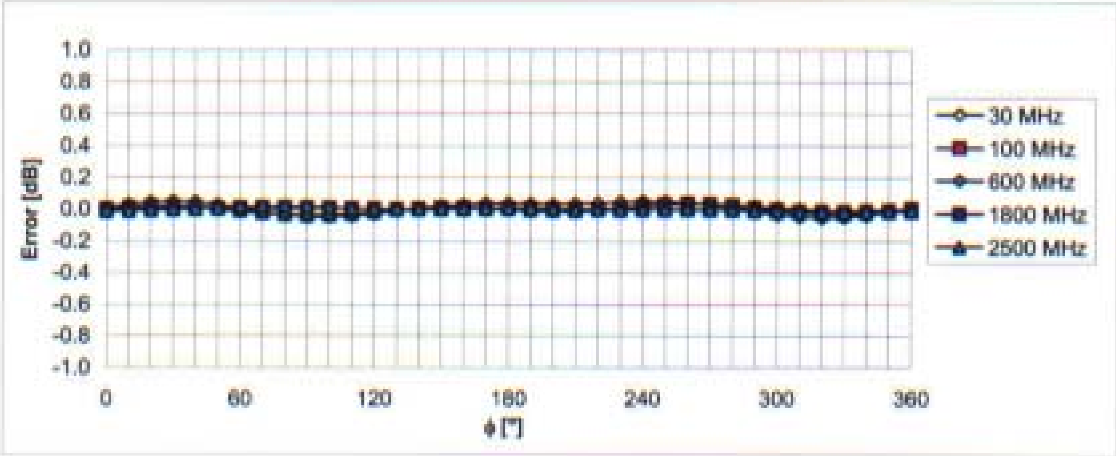


Receiving Pattern (ϕ), $\vartheta = 90°$



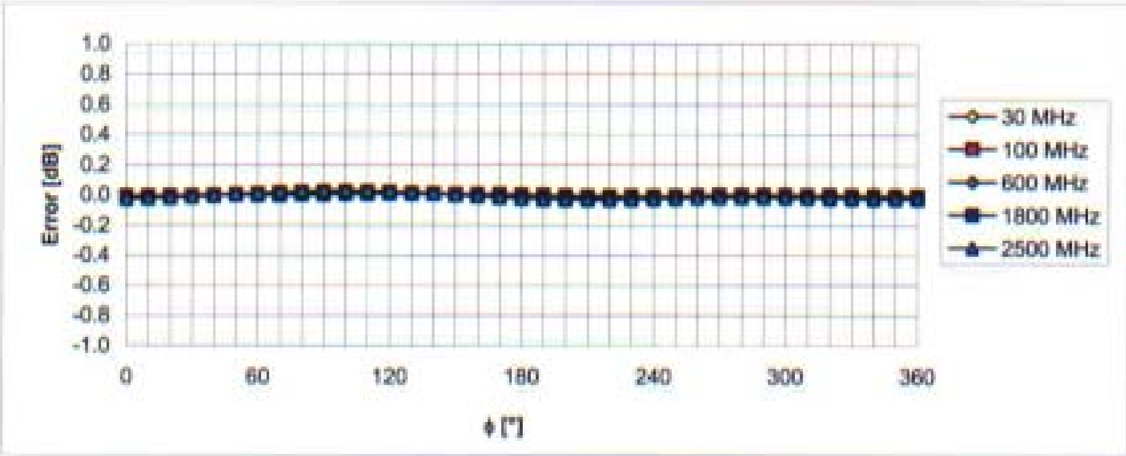


Receiving Pattern (ϕ), ϑ = 0°



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

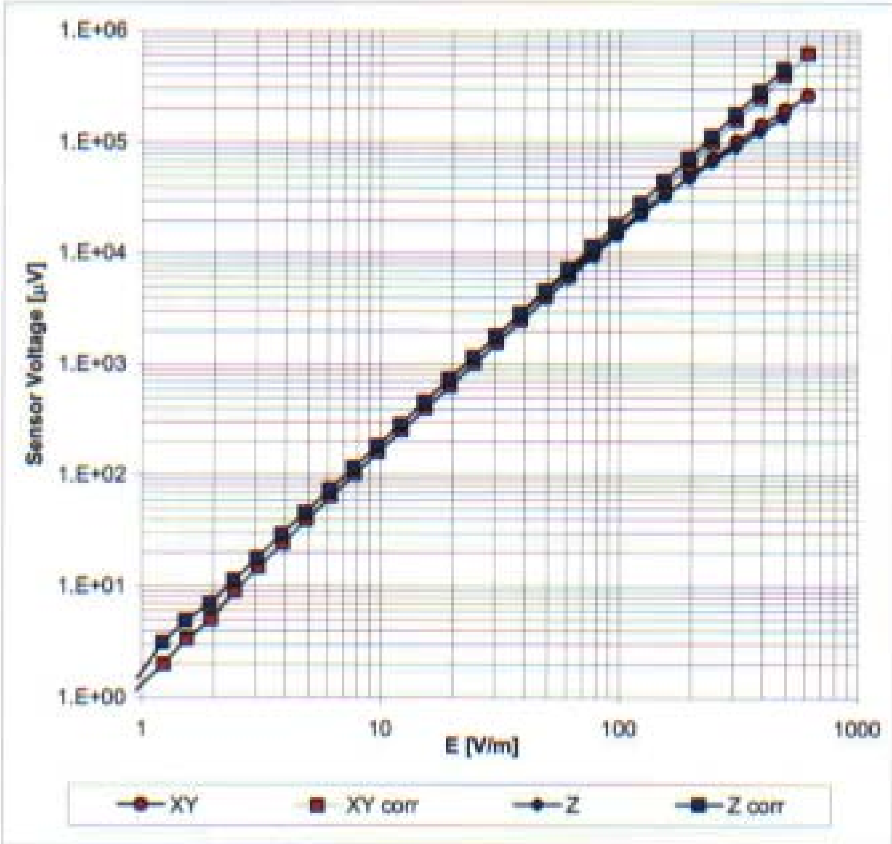
Receiving Pattern (ϕ), ϑ = 90°

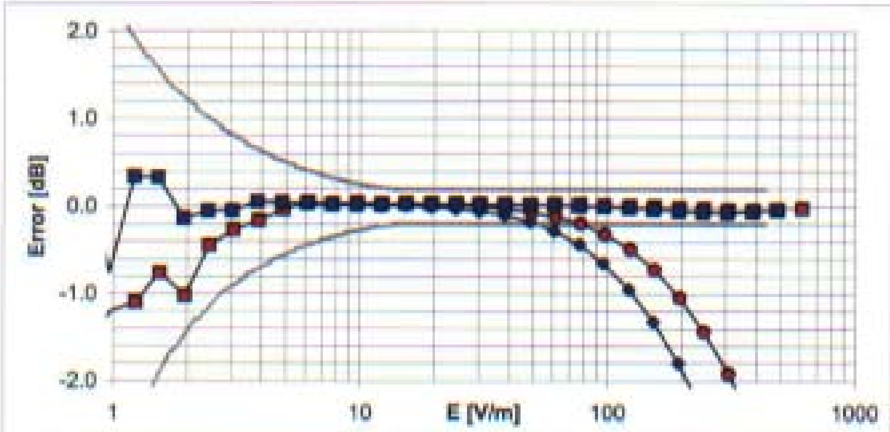


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(E-field)

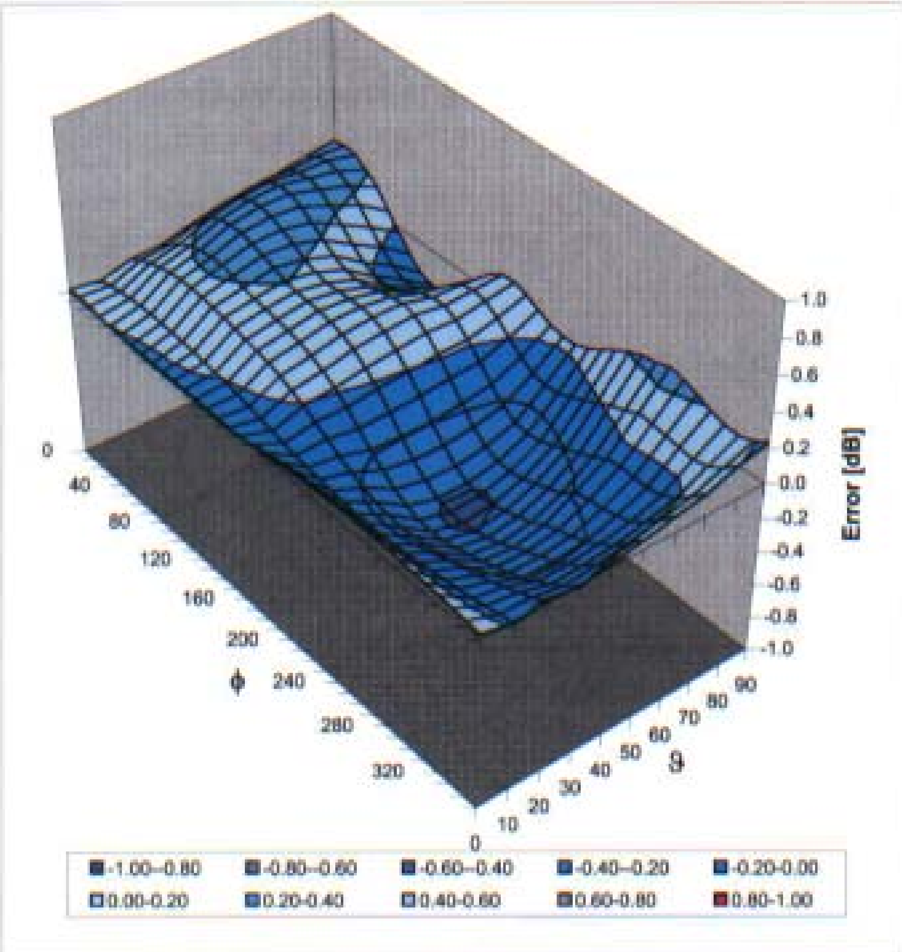
(Waveguide R22, f = 1800 MHz)





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)

Probe Calibration(H-field)

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

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

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 C (Dymstec)**

Certificate No: **H3-6197_Apr07**

CALIBRATION CERTIFICATE

Object	H3DV6 - SN:6197
Calibration procedure(s)	QA CAL-03.v5 Calibration procedure for H-field probes optimized for close near field evaluations in air
Calibration date:	April 20, 2007
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41495277	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41498087	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-06 (METAS, No. 217-00592)	Aug-07
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-07 (METAS, No. 217-00671)	Mar-08
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-06 (METAS, No. 217-00593)	Aug-07
Reference Probe H3DV6	SN: 6182	2-Oct-06 (SPEAG, No. H3-6182_Oct06)	Oct-07
DAE4	SN: 907	20-Jul-06 (SPEAG, No. DAE4-907_Jul06)	Jul-07
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	i.V. F. Bomholt

Issued: April 21, 2007

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

OK to use
2007. 5. 16

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe H3DV6

SN:6197

Manufactured:	April 18, 2006
Last calibrated:	May 16, 2006
Recalibrated:	April 20, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: H3DV6 SN:6197

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

	a0	a1	a2
X	**2.383E-03**	**1.412E-4**	**9.113E-5** ± 5.1 % (k=2)
Y	**2.333E-03**	**2.203E-4**	**9.588E-5** ± 5.1 % (k=2)
Z	**2.777E-03**	**7.033E-5**	**7.586E-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

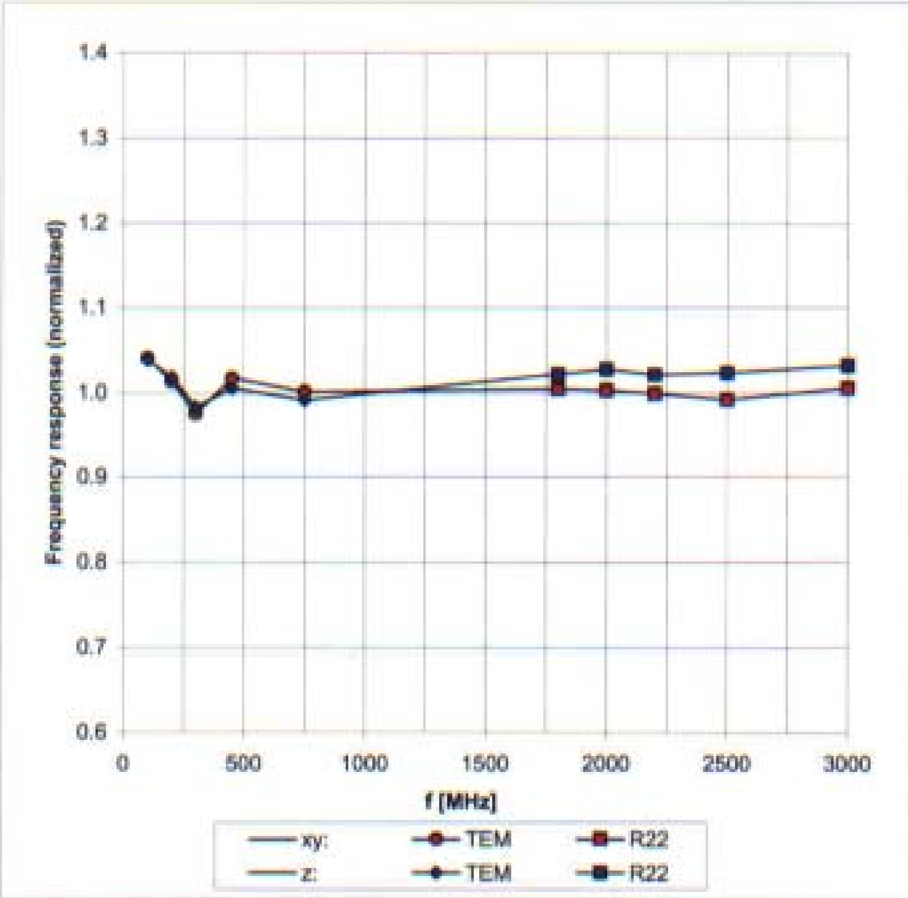
Connector Angle **-201** °

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

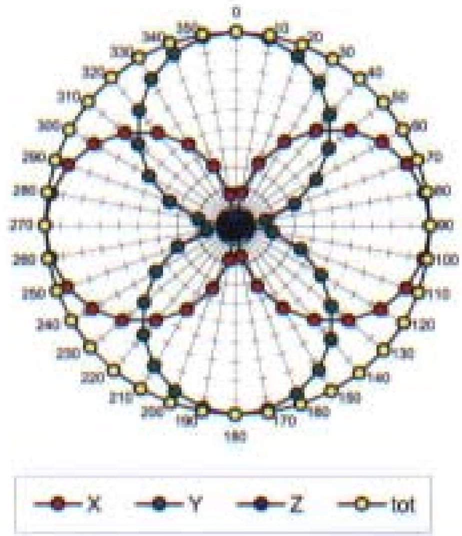
(TEM-Cell:ifi110, Waveguide R22)



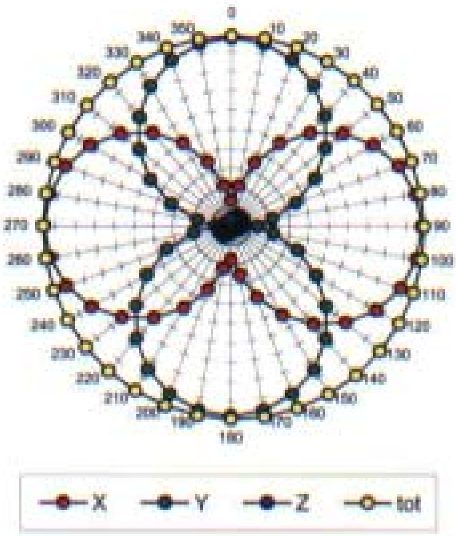
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (φ), ϑ = 90°

f = 300 MHz, TEM ifi110EXX

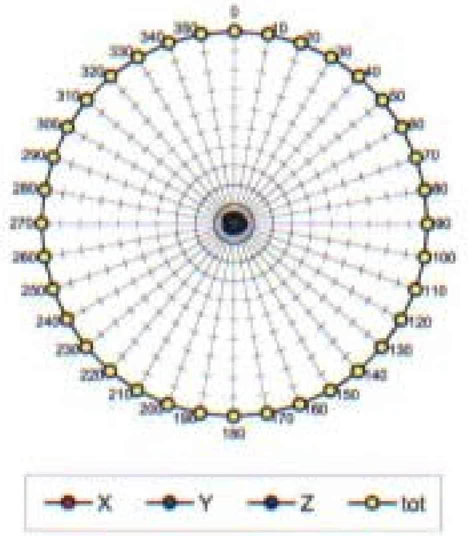


f = 2500 MHz, WG R22

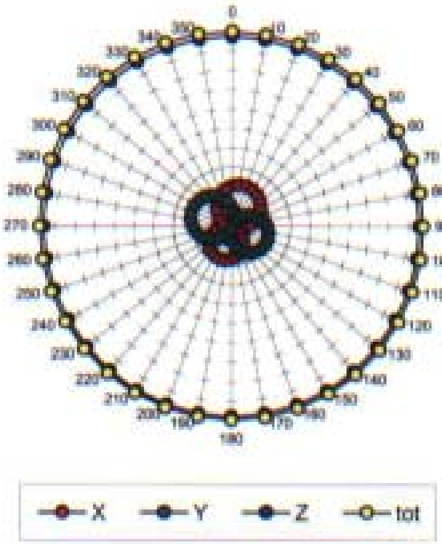


Receiving Pattern (φ), ϑ = 0°

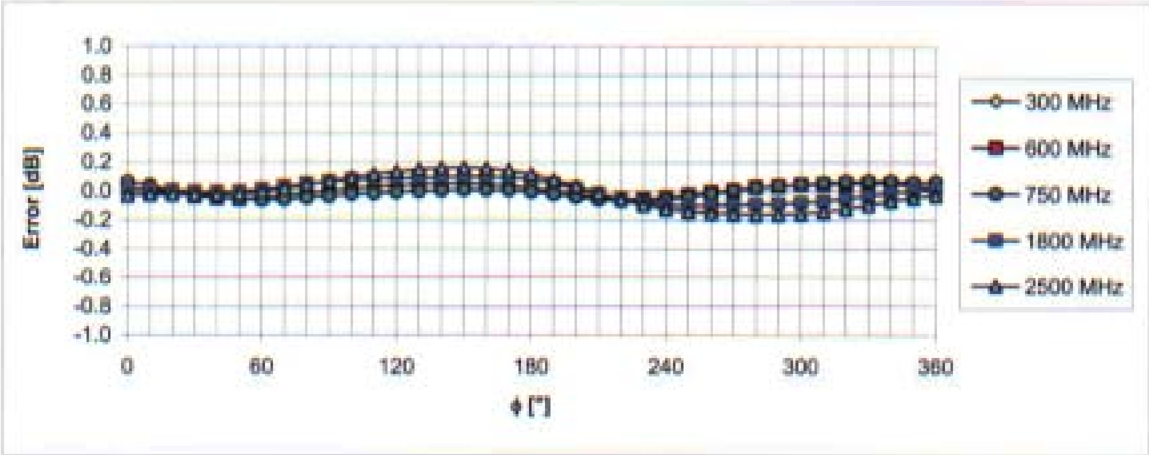
f = 300 MHz, TEM ifi110EXX



f = 2500 MHz, WG R22

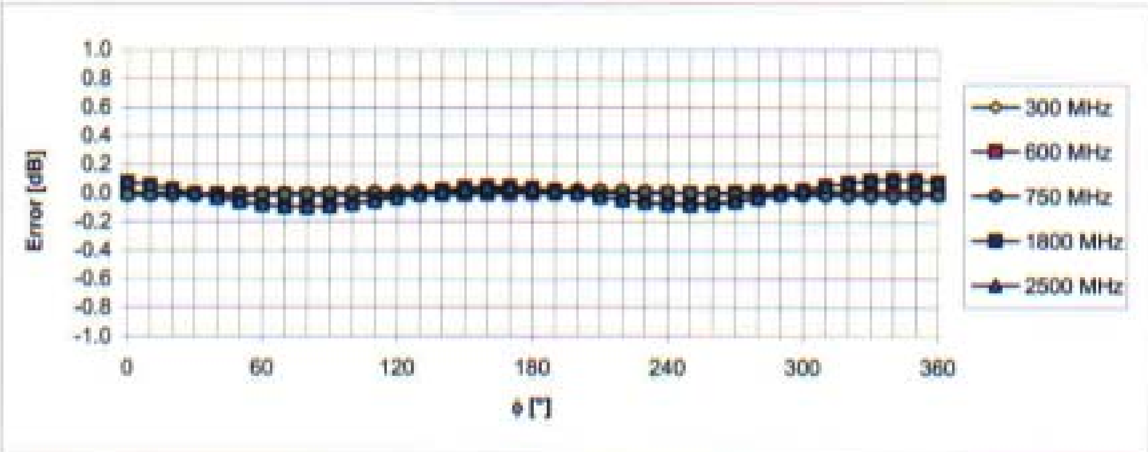


Receiving Pattern (ϕ), ϑ = 90°



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

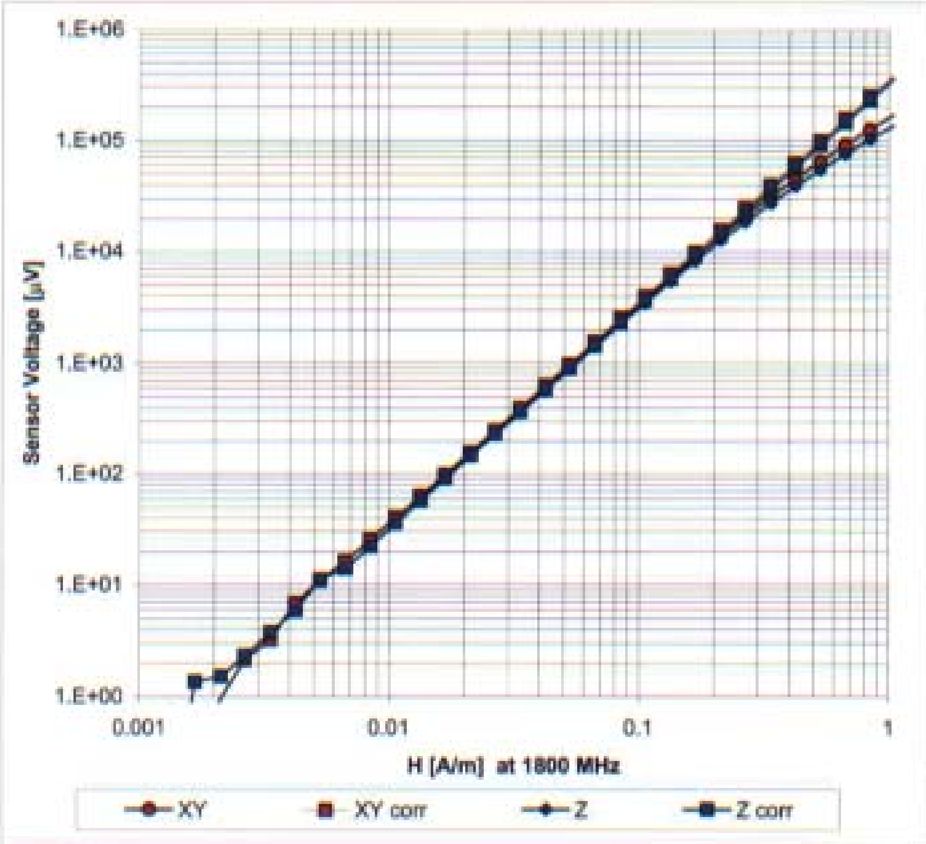
Receiving Pattern (ϕ), ϑ = 0°

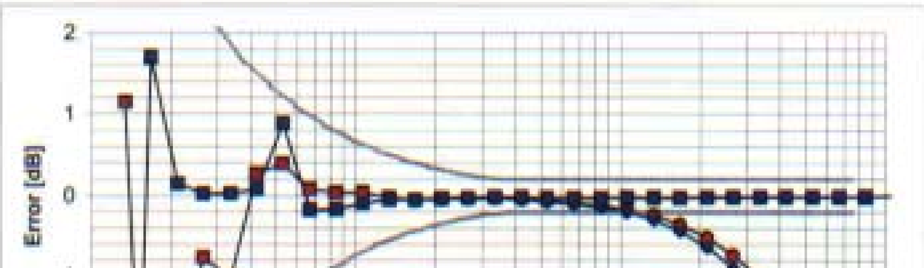


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(H-field)

(Waveguide R22, f = 1800 MHz)





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

APPENDIX F

Calibration of The Validation Dipole

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**
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 (Dymstec)**

Certificate No: CD1880V3-1074_Feb07

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1074
Calibration procedure(s)	QA CAL-20.v4 Calibration procedure for dipoles in air
Calibration date:	February 12, 2007
Condition of the calibrated item	In Tolerance

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
DAE4	SN: 660	1-Mar-06 (SPEAG, No. DAE4-660_Mar06)	Calibration, Mar-07
Probe ER3DV6	SN: 2336	27-Dec-06 (SPEAG, No. ER3-2336_Dec06)	Calibration, Dec-07
Probe H3DV6	SN: 6065	27-Dec-06 (SPEAG, No. H3-6065-Dec06)	Calibration, Dec-07

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-4419B	GB43310788	12-Aug-03 (SPEAG, in house check Oct-06)	In house check: Oct-07
Power sensor HP 8481A	MY41093312	10-Aug-03 (SPEAG, in house check Oct-06)	In house check: Oct-08
Power sensor HP 8481A	MY41093315	10-Aug-03 (SPEAG, in house check Oct-06)	In house check: Oct-08
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07
RF generator R&S SMT06	SN: 100005	26-Jul-04 (SPEAG, in house check Nov-05)	In house check: Nov-07

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

Issued: February 19, 2007

2007. 3. 8
ok to use

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	V4.7 B53
DASY PP Version	SEMCAD	V1.8 B172
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	**0.454 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	135.6 V/m
Maximum measured above low end	100 mW forward power	135.3 V/m
Averaged maximum above arm	100 mW forward power	**135.5 V/m**

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

3 Appendix

3.1 Antenna Parameters

Frequency	**Return Loss**	**Impedance**
1710 MHz	18.5 dB	(46.9 + j11.1) Ohm
1880 MHz	**22.3 dB**	**(52.4 + j7.5) Ohm**
1900 MHz	22.5 dB	(54.8 + j6.2) Ohm
1950 MHz	30.3 dB	(52.2 – j2.2) Ohm
2000 MHz	19.1 dB	(40.0 + j0.9) 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.

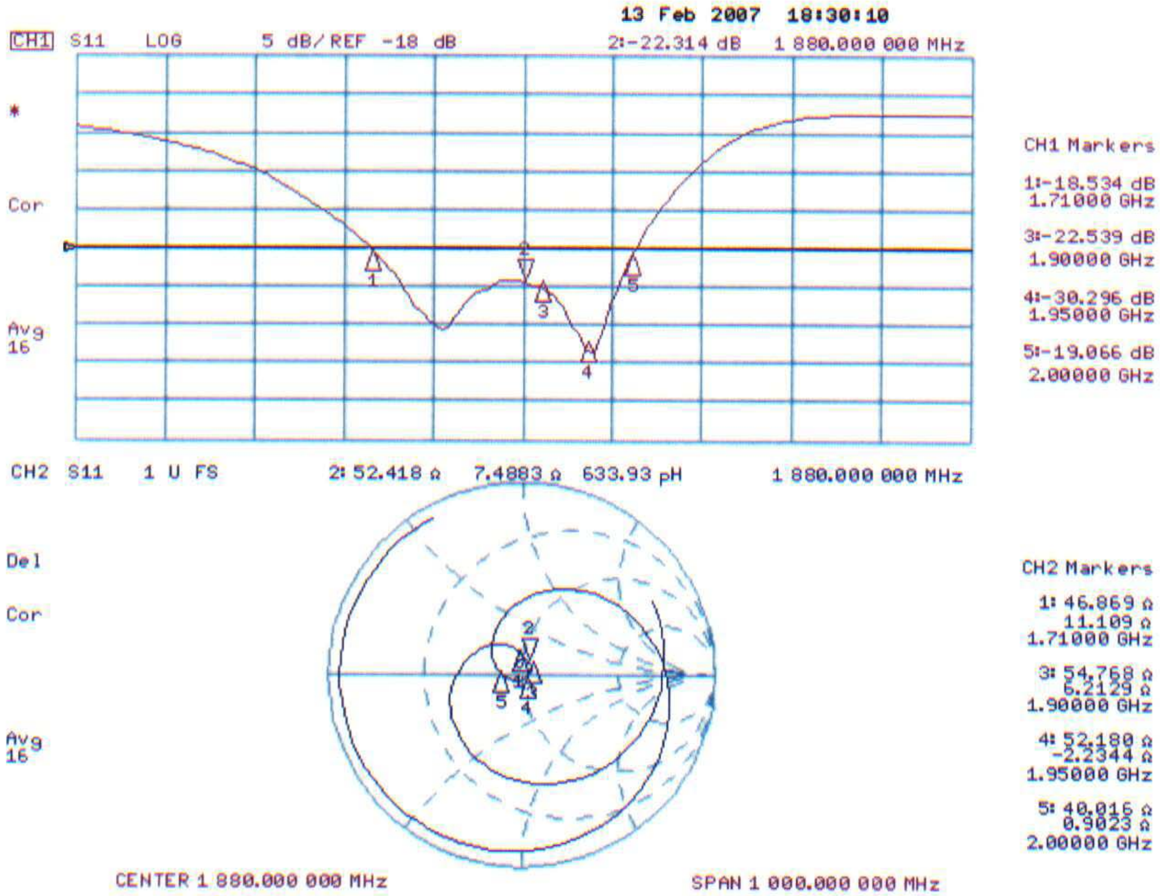
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

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: 12.02.2007 17:56:53

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1074

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

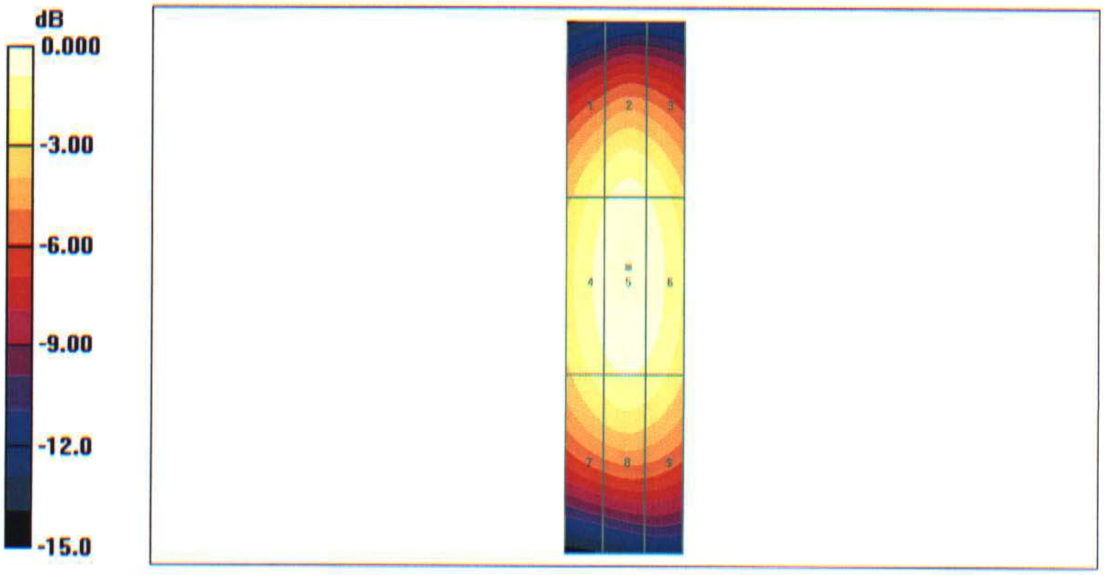
DASY4 Configuration:

- Probe: H3DV6 - SN6065; Calibrated: 27.12.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 01.03.2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

H Scan - Sensor Center 10mm above CD1880V3 Dipole/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.454 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.479 A/m; Power Drift = 0.006 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.394**	Grid 2 **0.424**	Grid 3 **0.408**
Grid 4 **0.427**	Grid 5 **0.454**	Grid 6 **0.439**
Grid 7 **0.386**	Grid 8 **0.409**	Grid 9 **0.396**



0 dB = 0.454A/m

3.3.3 DASY4 E-Field Result

Date/Time: 2/12/2007 4:20:23 PM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1074

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

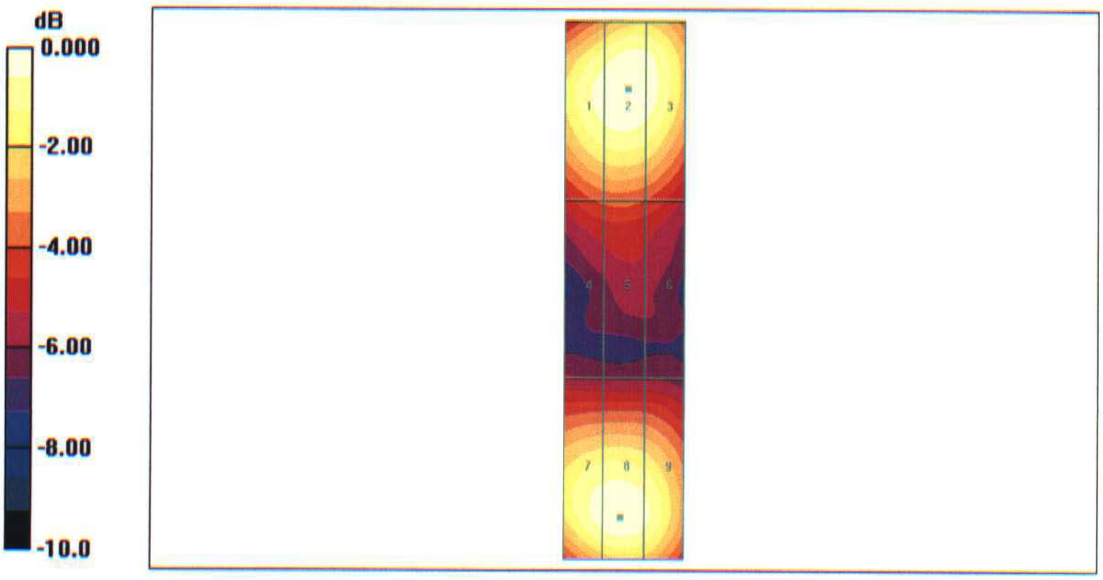
DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 12/27/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 3/1/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

E Scan - Sensor Center 10mm above CD1880V3 Dipole/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 135.6 V/m
Probe Modulation Factor = 1.00
Reference Value = 151.3 V/m; Power Drift = -0.011 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **131.2**	Grid 2 **135.6**	Grid 3 **132.6**
Grid 4 **88.1**	Grid 5 **89.2**	Grid 6 **85.9**
Grid 7 **131.5**	Grid 8 **135.3**	Grid 9 **129.1**



0 dB = 135.6V/m