



Probe Calibration(E-field)



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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 $(22 \pm 3)^\circ\text{C}$ 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	MY41496277	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41496087	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	

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:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

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 [$\mu\text{V}/(\text{V}/\text{m})^2$]		Diode Compression ^A	
NormX	1.74 ± 10.1 % (k=2)	DCP X	95 mV
NormY	1.62 ± 10.1 % (k=2)	DCP Y	95 mV
NormZ	1.96 ± 10.1 % (k=2)	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

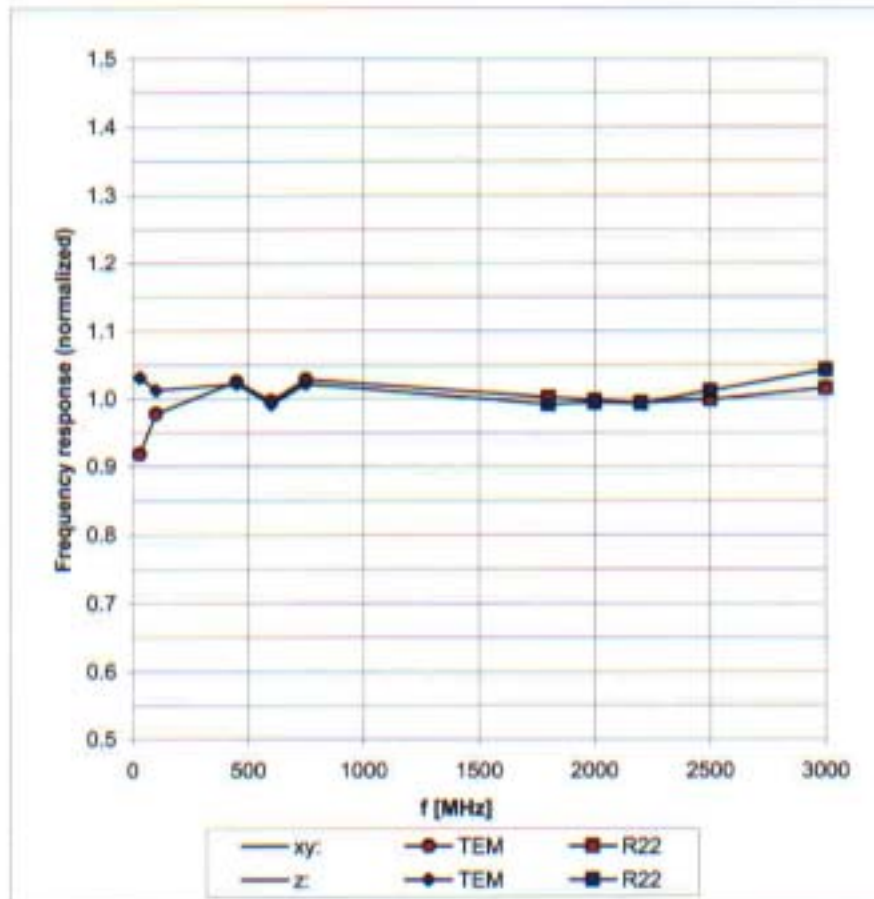
Connector Angle -45 °

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

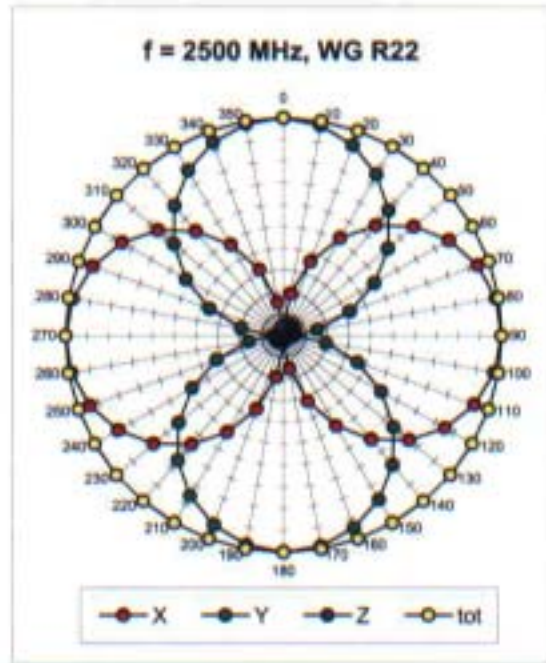
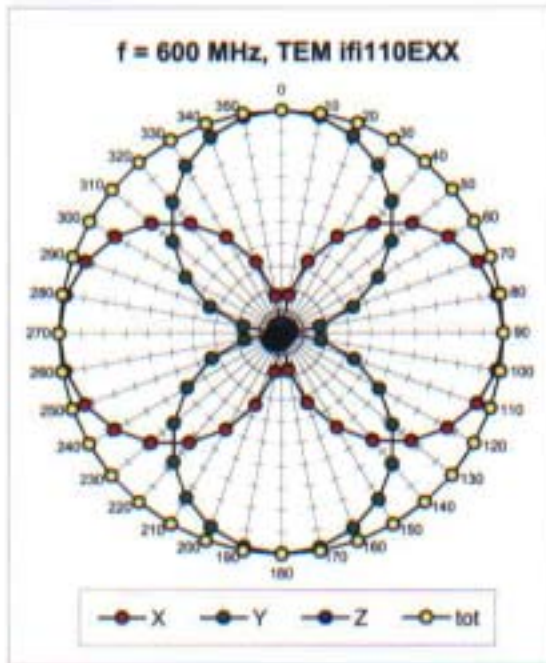
Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide R22)

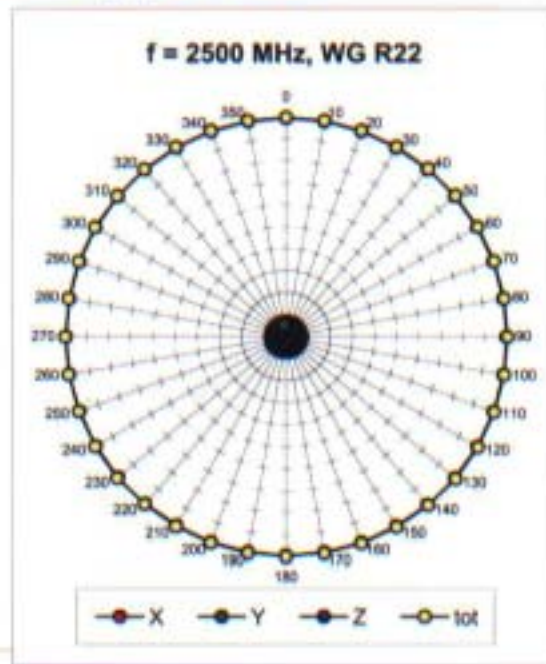
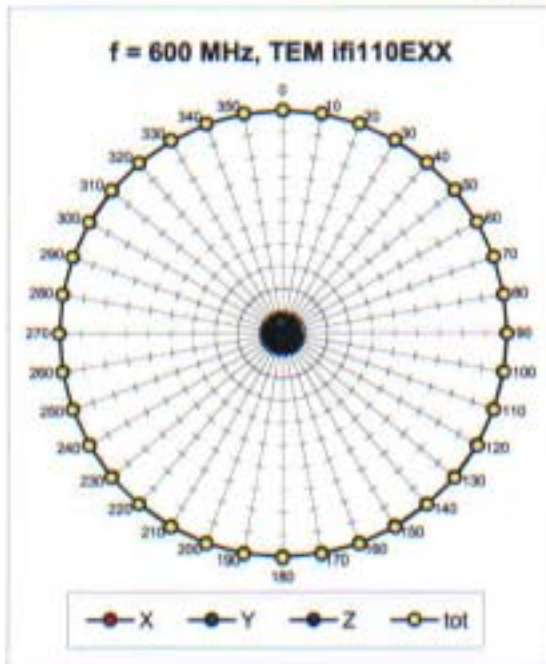


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

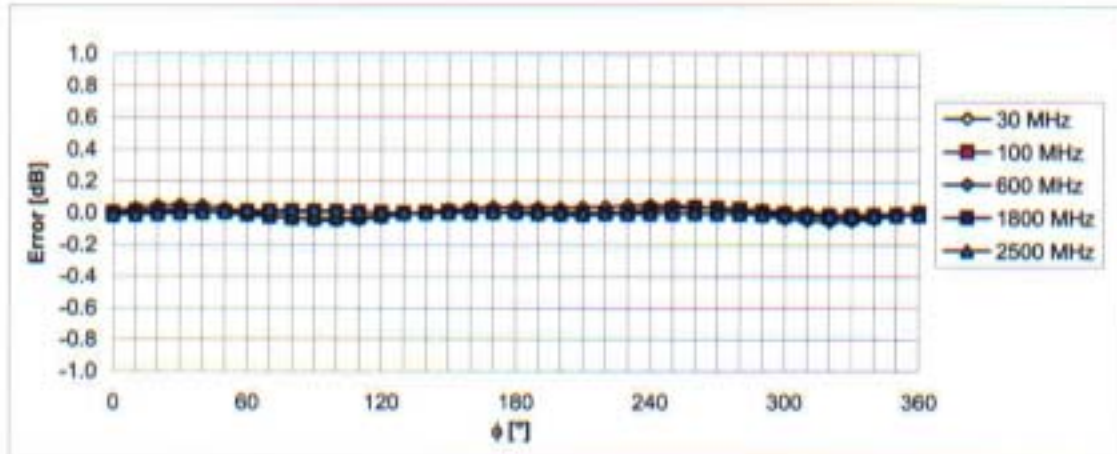
Receiving Pattern (ϕ), $\vartheta = 0^\circ$



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

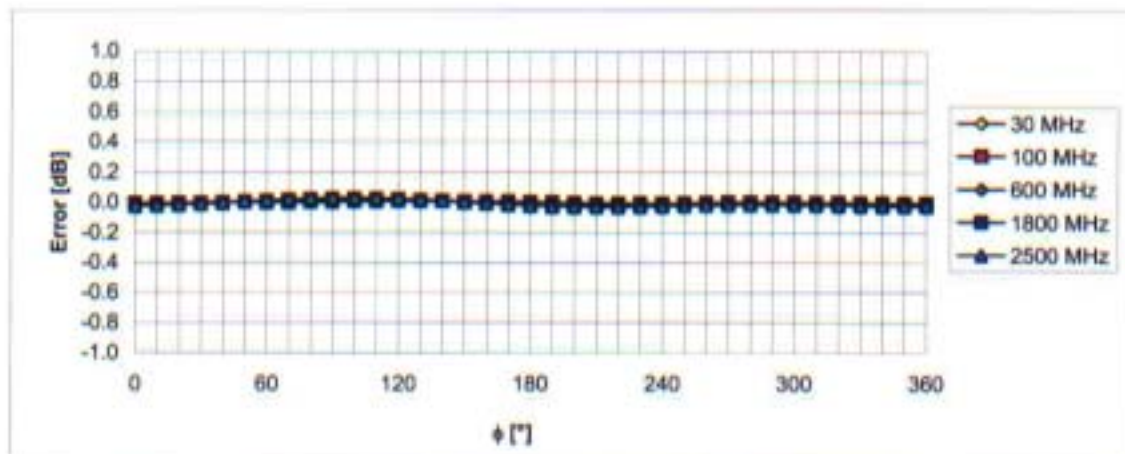


Receiving Pattern (ϕ), $\vartheta = 0^\circ$



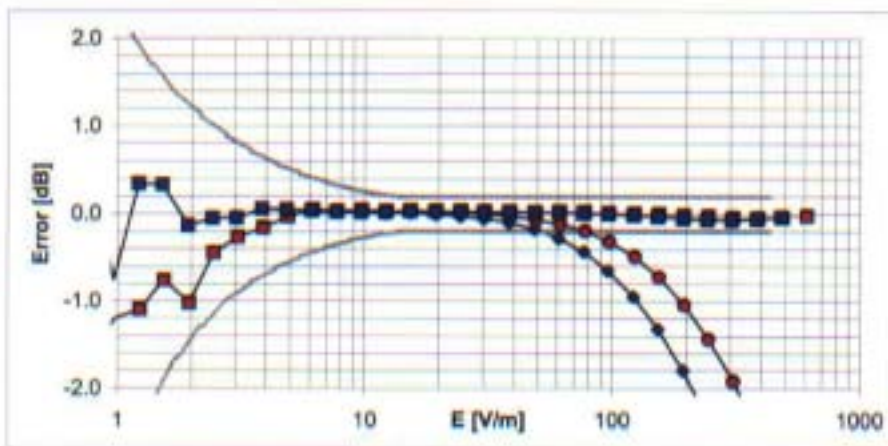
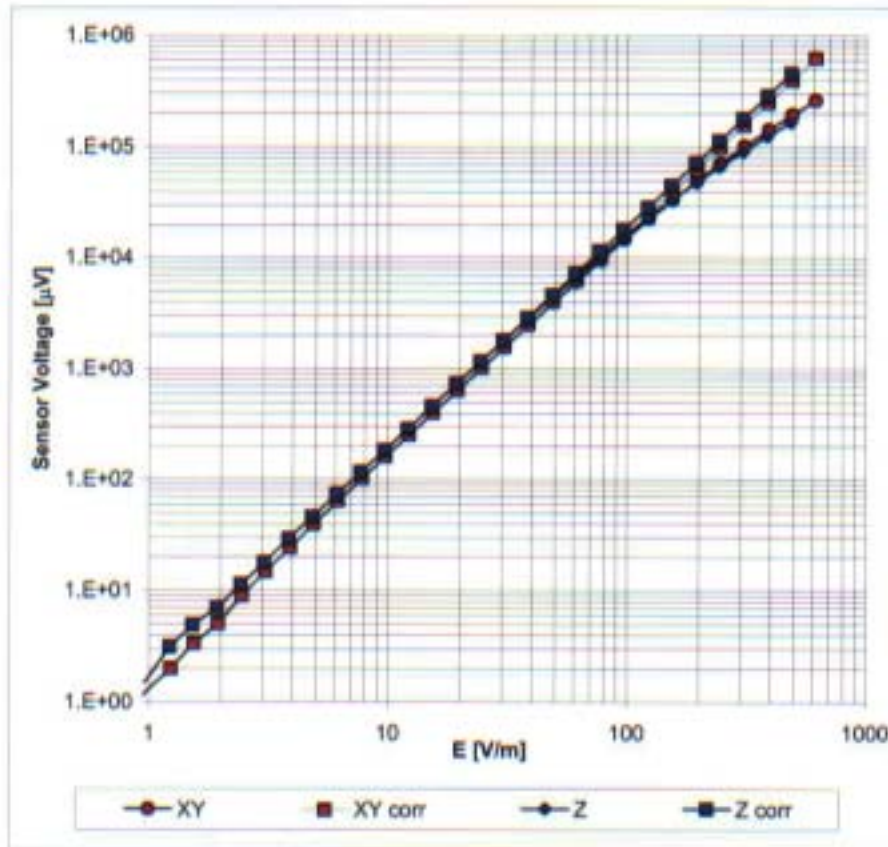
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



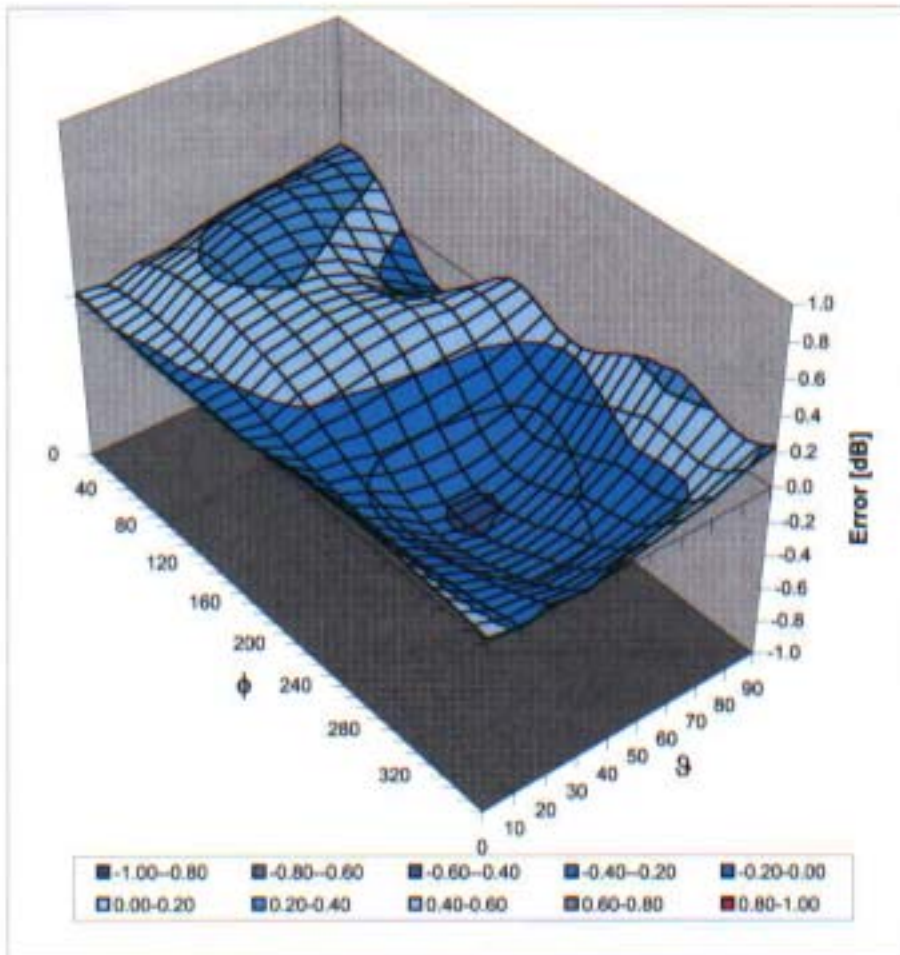
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



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

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



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



APPENDIX E

Probe Calibration(H-field)



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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 $(22 \pm 3)^{\circ}\text{C}$ 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	GB41293574	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 8645C	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

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

Issued: April 21, 2007

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OK to use

2007.5.16



Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- X, Y, Z_{a0a1a2} : Assessed for E-field polarization $\vartheta = 90$ for XY sensors and $\vartheta = 0$ for Z sensor ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide).
- $X, Y, Z(f)_{a0a1a2} = X, Y, Z_{a0a1a2} \cdot \text{frequency_response}$ (see Frequency Response Chart).
- $DCP_{x,y,z}$: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency.
- Spherical isotropy (3D deviation from isotropy)*: in a locally homogeneous field realized using an open waveguide setup.
- Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle*: The angle is assessed using the information gained by determining the X_{a0a1a2} (no uncertainty required).

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:6197Sensitivity in Free Space [A/m / $\sqrt{\mu\text{V}}$]

	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 Compression¹

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

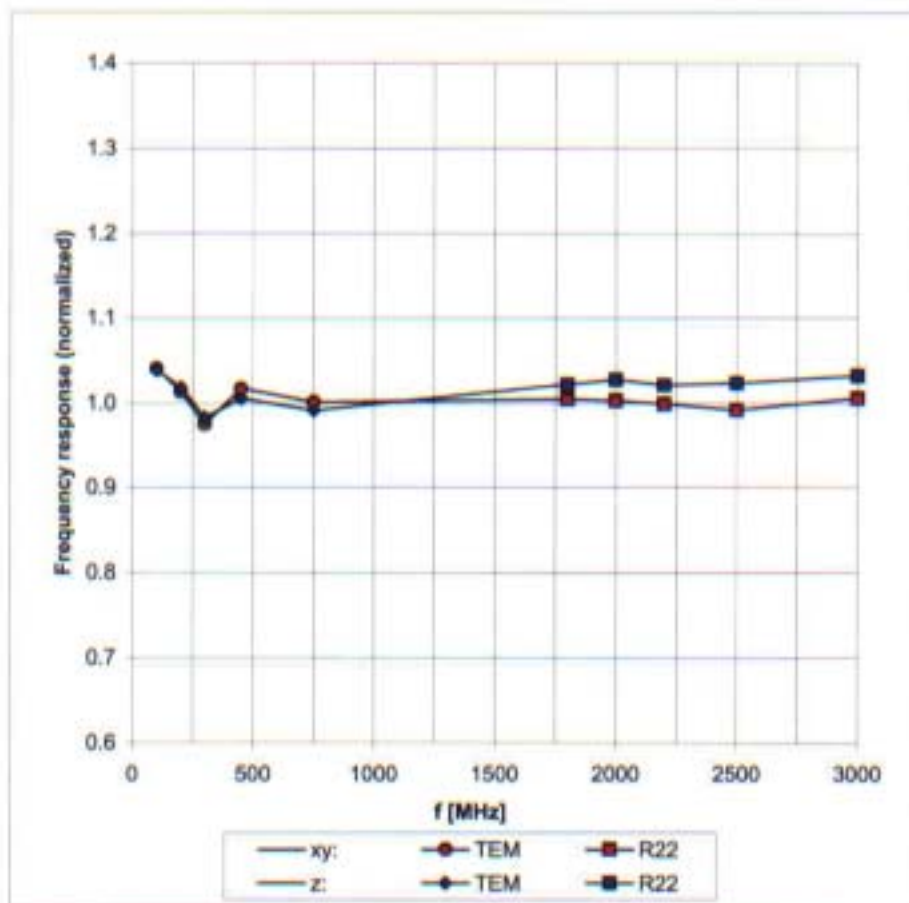
Connector Angle

-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%.

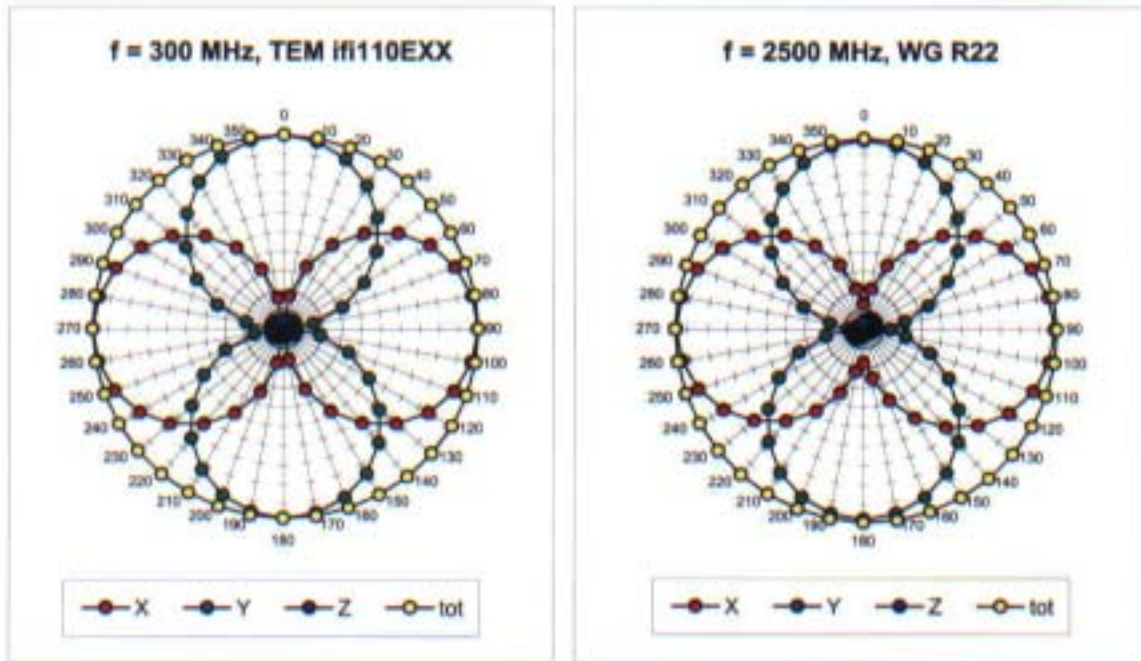
¹ numerical linearization parameter: uncertainty not required

Frequency Response of H-Field (TEM-Cell:ifi110, Waveguide R22)

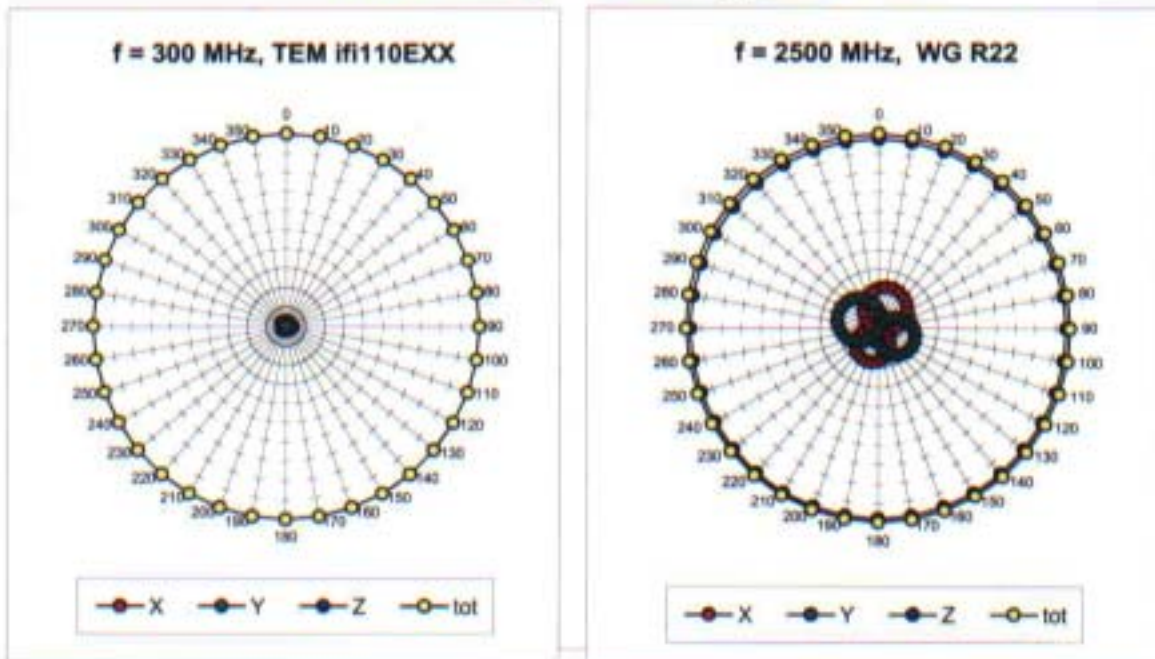


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

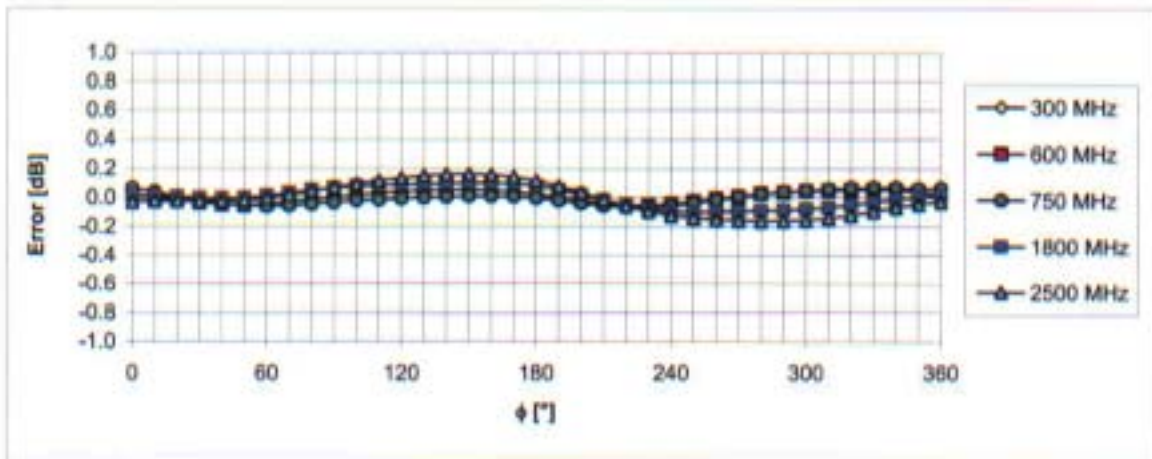
Receiving Pattern (ϕ), $\vartheta = 90^\circ$



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

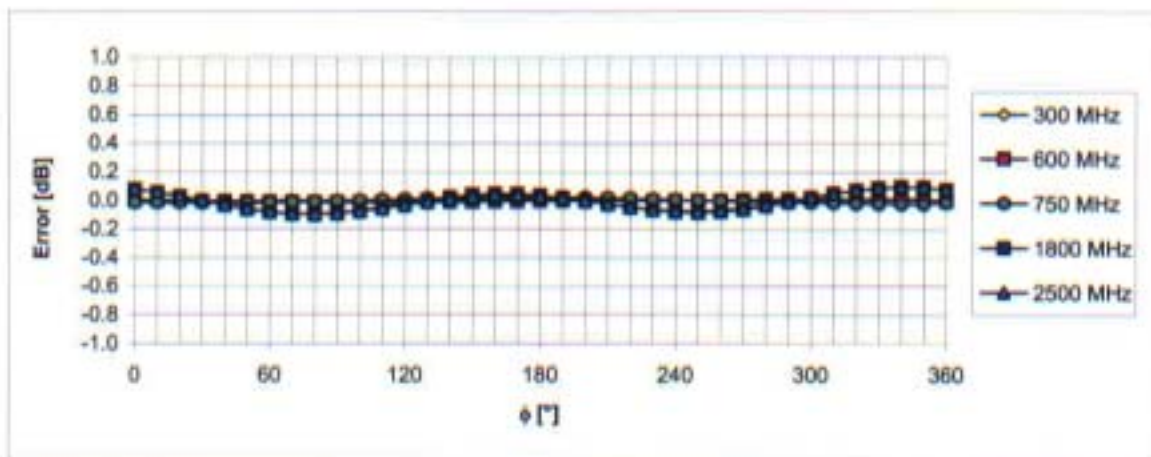


Receiving Pattern (ϕ), $\vartheta = 90^\circ$



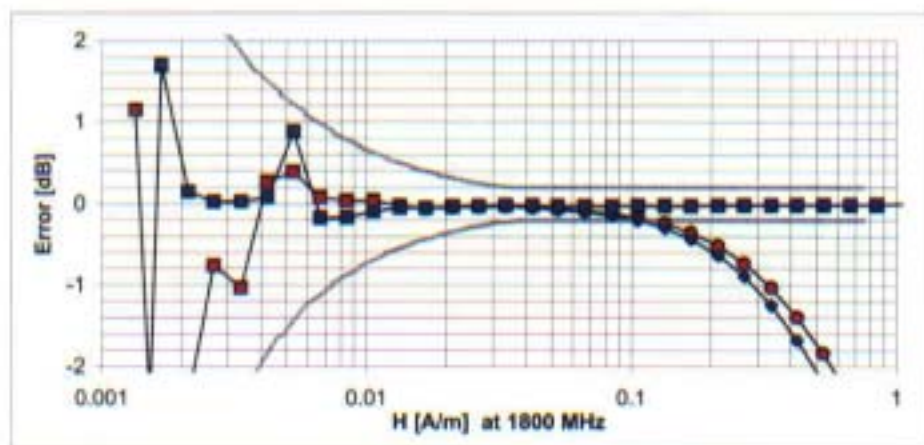
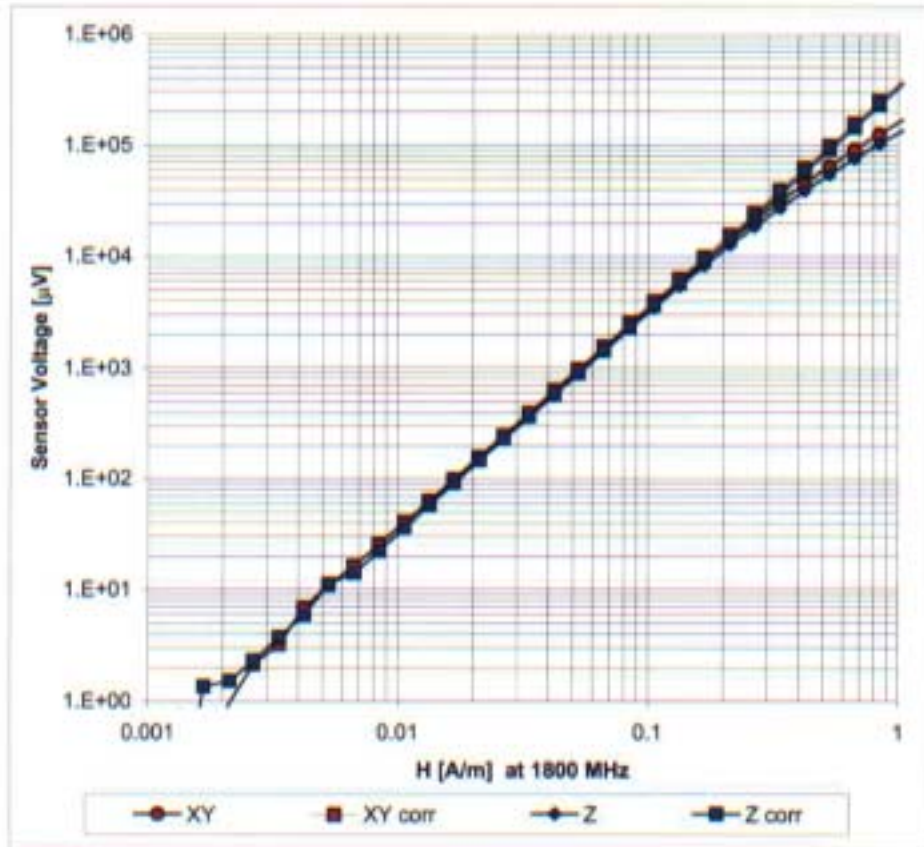
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

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



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

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



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



APPENDIX F

Calibration of The Validation Dipole



Accredited by the Swiss Federal Office of Metrology and Accreditation
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Samsung C (Dymstec)**

Certificate No: CD835V3-1021_Mar07/2

CALIBRATION CERTIFICATE (Replacement of No: CD835V3-1021_Mar07)

Object: CD835V3 - SN: 1021

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

Calibration date: March 21, 2007

Condition of the calibrated item: In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
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: 903	31-Aug-06 (SPEAG, No. DAE4-903_Aug06)	Calibration, Aug-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

Calibrated by: Name: Claudio Leubler, Function: Laboratory Technician, Signature: *C. Leubler*

Approved by: Name: Katja Pokovic, Function: Technical Manager, Signature: *K. Pokovic*

Issued: August 29, 2007

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

OK to use
Sep 18, 2007



Accredited by the Swiss Federal Office of Metrology and Accreditation
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

References

- [1] ANSI-C63.19-2006
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 eliminated by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- **E-field distribution:** E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], 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 180 mm
Frequency	835 MHz ± 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.08 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	interpolated maximum
Maximum measured	100 mW forward power	0.451 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	165.5 V/m
Maximum measured above low end	100 mW forward power	162.0 V/m
Averaged maximum above arm	100 mW forward power	163.5 V/m

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

3 Appendix

3.1 Antenna Parameters

Frequency	Return Loss	Impedance
800 MHz	16.7 dB	(43.8 – j12.4) Ohm
835 MHz	25.9 dB	(52.0 + j4.7) Ohm
900 MHz	16.6 dB	(56.0 – j14.7) Ohm
950 MHz	22.8 dB	(45.4 + j5.2) Ohm
960 MHz	18.3 dB	(51.2 + j12.3) Ohm

3.2 Antenna Design and Handling

The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.

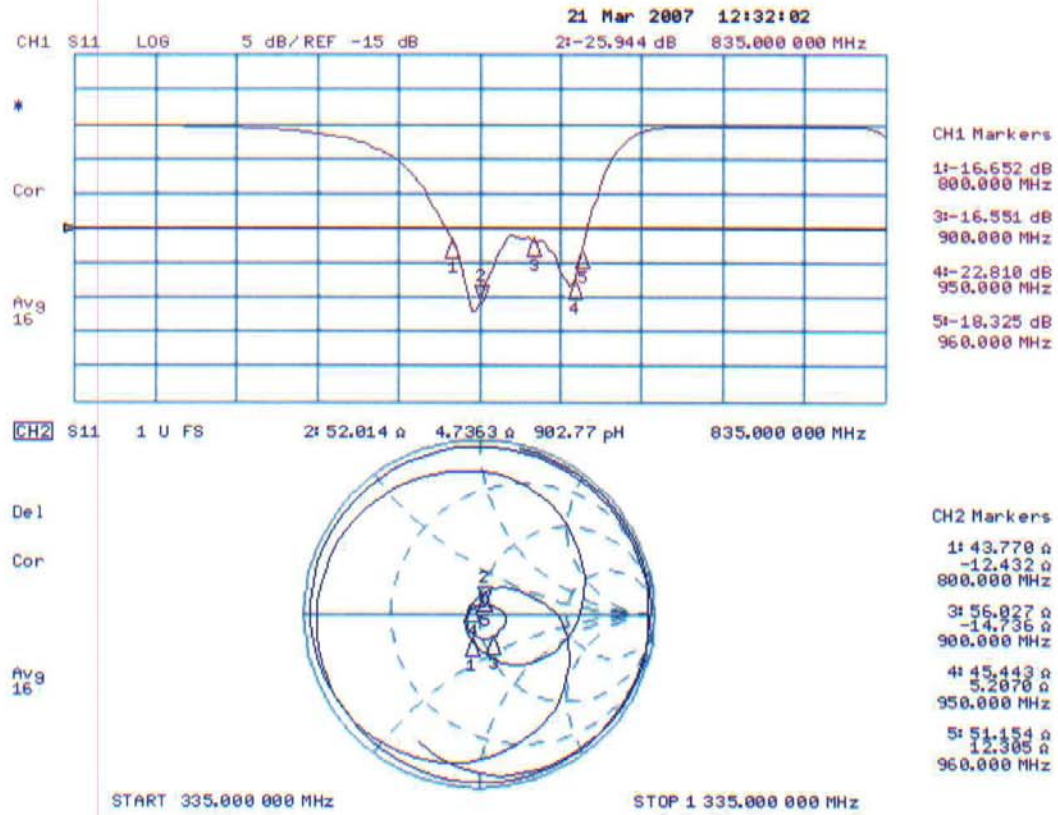
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

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

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

3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



3.3.2 DASY4 H-field result

Date/Time: 19.03.2007 16:02:47

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: 1021

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

Medium: Air

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

Phantom section: H Dipole Section

DASY4 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 27.12.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn903; Calibrated: 31.08.2006
- 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 CD835 Dipole/Hearing Aid Compatibility Test (41x361x1):

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

Maximum value of peak Total field = 0.451 A/m

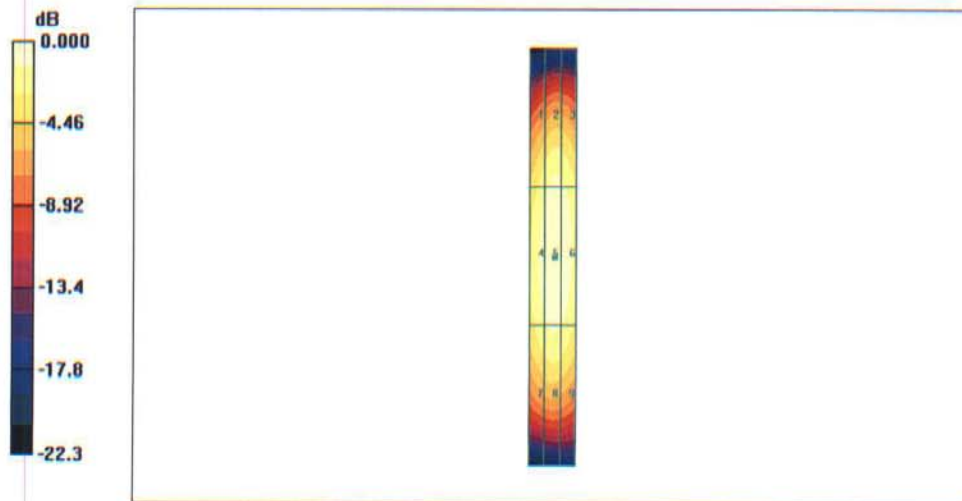
Probe Modulation Factor = 1.00

Reference Value = 0.477 A/m; Power Drift = 0.016 dB

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

Peak H-field in A/m

Grid 1	Grid 2	Grid 3
0.358	0.399	0.390
Grid 4	Grid 5	Grid 6
0.415	0.451	0.438
Grid 7	Grid 8	Grid 9
0.371	0.397	0.384



0 dB = 0.451A/m

3.3.3 DASY4 E-Field result

Date/Time: 19.03.2007 14:34:05

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: 1021

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

Medium: Air

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

Phantom section: E Dipole Section

DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 27.12.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn903; Calibrated: 31.08.2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

E Scan - Sensor Center 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1):

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

Maximum value of peak Total field = 165.5 V/m

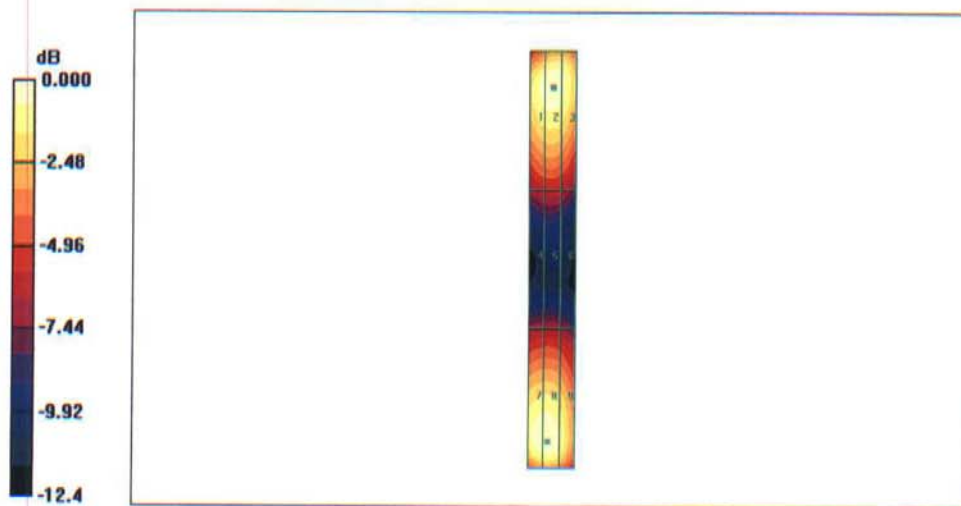
Probe Modulation Factor = 1.00

Reference Value = 109.0 V/m; Power Drift = -0.018 dB



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

Peak E-field in V/m

Grid 1	Grid 2	Grid 3
157.9	162.0	156.4
Grid 4	Grid 5	Grid 6
83.1	84.3	80.9
Grid 7	Grid 8	Grid 9
164.3	165.5	150.7



REPORT ON NON-CONFORMANCE

CUSTOMER: Samsung (Dymstec)	CONTACT PERSON: Sun Kim (Dymstec)
ARRIVAL DATE: 13. February 2007	OFFER. # 4356
DESCRIPTION OF NONCONFORMITY, DEFECT OR UNDESIRABLE CONDITION: The end-user informed SPEAG on a small crack observed on the D1900V2 – SN:5d023 dipole (e-mal from Dymstec on 12. February 2007). SPEAG noted this observation and it was agreed that the dipole will be checked prior its scheduled calibration in the February 12-23, 2007 calibration slot.	
EVALUATION OF NONCONFORMANCE BY Schmid & Partner Engineering AG: Upon arrival SPEAG visually inspected the D1900V2 – SN:5d023 dipole and came to the conclusion that the observed crack is only on the surface and has no influence on the electrical performance of the dipole. This has been verified also by measurements of the return loss and averaged SAR values, both of which were in tolerance (see dipole Certificate No. D1900V2-5d023_Feb07).	
CONCLUSION OF Schmid & Partner Engineering AG: The observation by SPEAG did not reveal any problems with the dipole. The observed crack is only on the dipole surface and does not have an influence neither to the electrical parameters of the dipole nor on the mechanical stability. The dipole was calibrated according to the QA CAL-05.v6 protocol and found to be in tolerance. After successful calibration, dipole was returned to the end-user.	
EVALUATION CONDUCTED BY:  Katja Pokovic	EVALUATION APPROVED BY:  Niels Kuster
DATE: 26 March 2007	DATE: 26 March 2007



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: **CD1880V3-1016_Mar07**

CALIBRATION CERTIFICATE

Object **CD1880V3 - SN: 1016**

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

Calibration date: **March 21, 2007**

Condition of the calibrated item **In Tolerance**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
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: 903	31-Aug-06 (SPEAG, No. DAE4-903_Aug06)	Calibration, Aug-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:	Claudio Leubler	Laboratory Technician	
Approved by:	Fin Bornholt	Technical Director	

Issued: March 22, 2007

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

OK to use.
[Signature] 2007.5.3.



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

Accreditation No.: **SCS 108**

References

- [1] ANSI-C63.19-2006
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 eliminated by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- *E-field distribution:* E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], 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	< 0.08 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	Interpolated maximum
Maximum measured	100 mW forward power	0.444 A/m

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

E-field 10 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW forward power	134.4 V/m
Maximum measured above low end	100 mW forward power	132.7 V/m
Averaged maximum above arm	100 mW forward power	133.6 V/m

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

3 Appendix

3.1 Antenna Parameters

Frequency	Return Loss	Impedance
1710 MHz	20.8 dB	(51.2 + j9.2) Ohm
1880 MHz	21.3 dB	(50.2 + j8.7) Ohm
1900 MHz	21.9 dB	(52.7 + j7.8) Ohm
1950 MHz	30.6 dB	(53.0 + j0.7) Ohm
2000 MHz	21.0 dB	(42.4 + j3.1) Ohm

3.2 Antenna Design and Handling

The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.

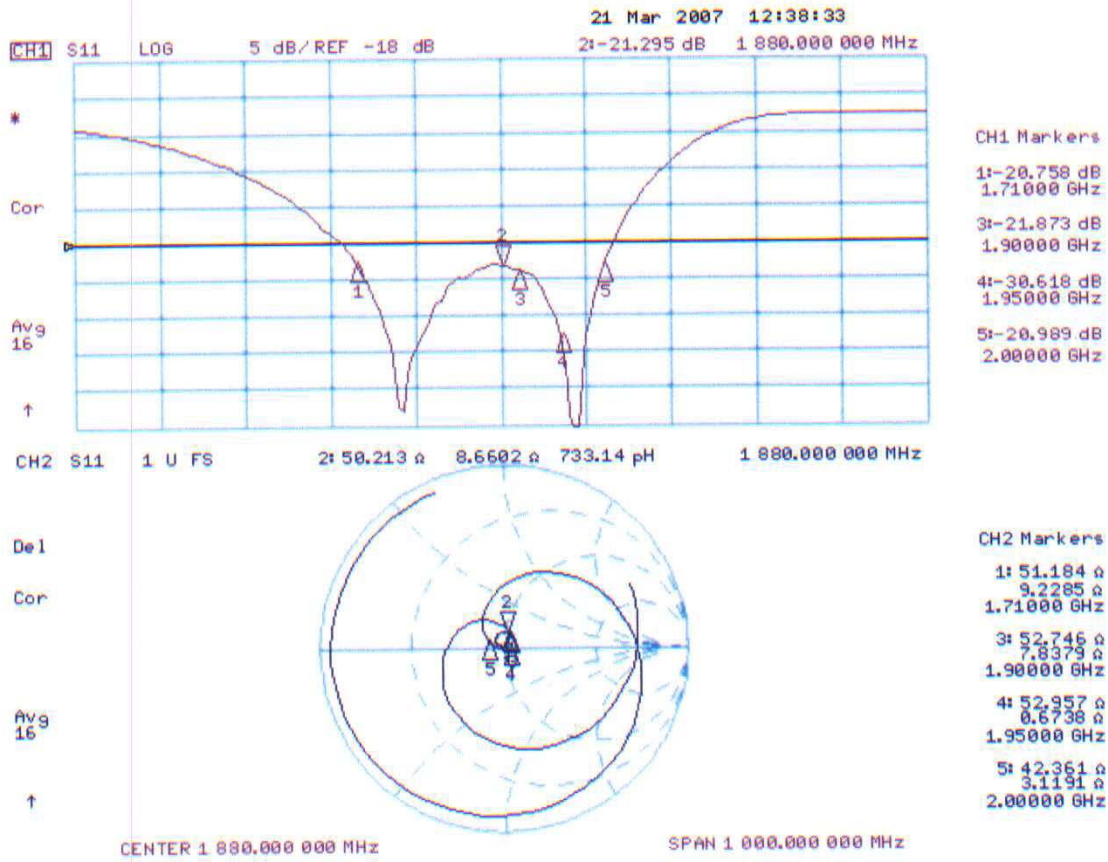
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

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

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

3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



3.3.2 DASYS4 H-Field Result

Date/Time: 19.03.2007 17:03:12

Test Laboratory: SPEAG, Zurich, Switzerland

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, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Phantom section: H Dipole Section

DASY4 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 27.12.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn903; Calibrated: 31.08.2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASYS4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

H Scan - Sensor Center 10mm above CD1880V3 Dipole 2/Hearing Aid Compatibility Test (41x181x1):

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

Maximum value of peak Total field = 0.444 A/m

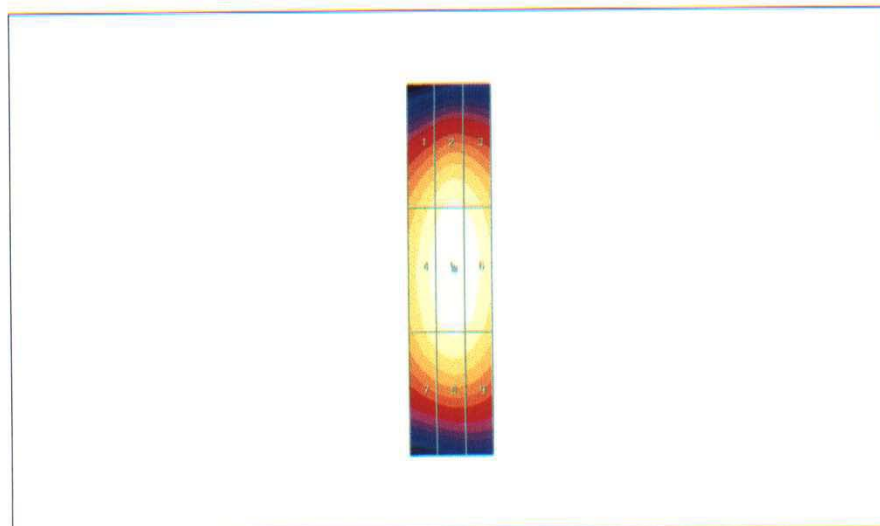
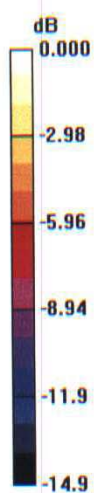
Probe Modulation Factor = 1.00

Reference Value = 0.467 A/m; Power Drift = -0.004 dB

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

Peak H-field in A/m

Grid 1	Grid 2	Grid 3
0.369	0.406	0.397
Grid 4	Grid 5	Grid 6
0.411	0.444	0.434
Grid 7	Grid 8	Grid 9
0.380	0.406	0.396



0 dB = 0.444A/m

3.3.3 DASY4 E-Field Result

Date/Time: 19.03.2007 15:13:55

Test Laboratory: SPEAG, Zurich, Switzerland

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, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: E Dipole Section

DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 27.12.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn903; Calibrated: 31.08.2006
- 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 = 134.4 V/m

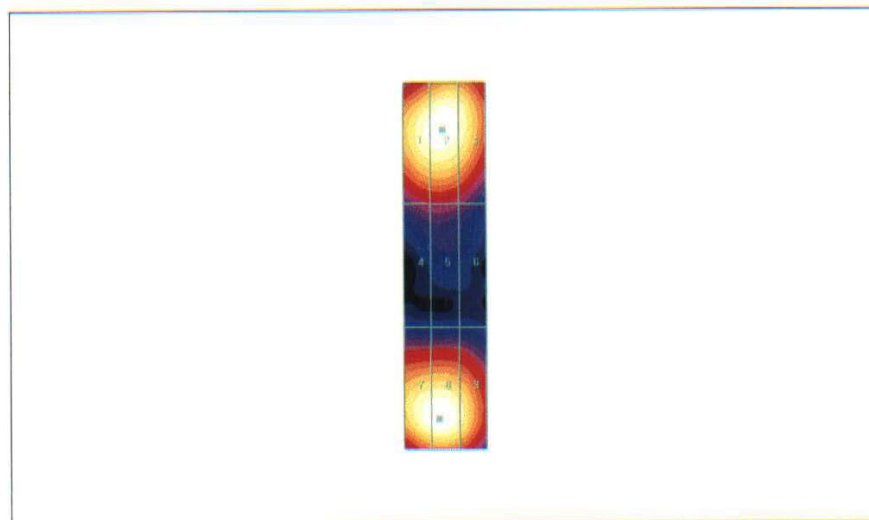
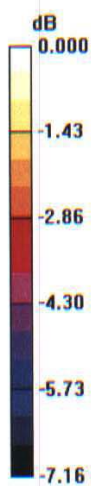
Probe Modulation Factor = 1.00

Reference Value = 148.0 V/m; Power Drift = 0.023 dB

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

Peak E-field in V/m

Grid 1	Grid 2	Grid 3
130.0	132.7	127.6
Grid 4	Grid 5	Grid 6
86.7	87.1	82.9
Grid 7	Grid 8	Grid 9
132.3	134.4	124.8



0 dB = 134.4V/m