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HAC RF Emissions Test Report

Test report no.:	Salo_HAC_0618_01	**Date of report:**	2006-05-05
Template version:	1.0	**Number of pages:**	25
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Responsible test engineer:	Virpi Tuominen	**Product contact person:**	Jukka Pekkala
Measurements made by:	Janne Hirsimäki, Ari Orte		
Tested devices:	RM-126 (Hearing aid mode), HW: 0572, 0573		
FCC ID:	PPIRM-126H	**IC:**	661U-RM126
Supplement reports:	-		
Testing has been carried out in accordance with:	**ANSI C63.19-2006** American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids		
Documentation:	The documentation of the testing performed on the tested devices is archived for 15 years at TCC Nokia.		
Test results:	**The tested device complies with the requirements in respect of all parameters subject to the test.** The test results and statements relate only to the items tested. The test report shall not be reproduced except in full, without written approval of the laboratory.		

Date and signatures:

For the contents:

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Virpi Tuominen
Test System Manager

CONTENTS

1. SUMMARY OF HAC RF EMISSION TEST REPORT

1.1 Test Details

Period of test	2006-04-26 to 2006-04-28
SN, HW, SW and DUT numbers of tested device	SN: 004400/85/172494/6, HW: 0572, SW: Vp ml3.13, DUT: 11196 SN: 004400/85/172399/7, HW: 0573, SW: Vp ml3.13, DUT: 11197
Batteries used in testing	BL-4C, DUT: 11194, 11195
State of sample	Prototype unit
Notes	-

1.2 Maximum Results

The maximum measured HAC RF emissions values and categories for electric and magnetic fields are given in section 1.2.1 and 1.2.2 respectively.

1.2.1 Electric field measurements

Band & Mode	Ch / Freq. (MHz)	Limit of E-field max. value in category M3 [V/m]	Maximum E-field value after exclusion [V/m]	Category
GSM850	251 / 848.8	149.6 – 266.1	263.8	**M3 (-5dB)**
GSM1900	251 / 848.8	47.3 – 84.1	78.7	**M3 (-5dB)**

1.2.2 Magnetic field measurements

Band & Mode	Ch / Freq. (MHz)	Limit of H-field max. value in category M3 [A/m]	Maximum H-field value after exclusion [A/m]	Category
GSM850	251 / 848.8	0.45 – 0.80	0.54	**M3 (-5dB)**
GSM1900	810 / 1909.8	0.14 – 0.25	0.18	**M3 (-5dB)**

1.2.3 Overall RF emissions category of the tested device

Band & Mode	Combined category (E- and H-fields)	Pass / Fail
GSM850	**M3 (-5dB)**	**PASS**
GSM1900	**M3 (-5dB)**	**PASS**

1.2.4 Maximum Drift

Maximum drift during measurements	-0.4 dB

1.2.5 Measurement Uncertainty

Extended Uncertainty (k=2) 95%, E-field	14.7 %
Extended Uncertainty (k=2) 95%, H-field	10.9 %

1.3 Description of the Device under test (DUT)

Modes and Bands of Operation	GSM 850 / 1900	GPRS 850 / 1900	EGPRS 850 / 1900	BT
Modulation Mode	GMSK	GMSK	GMSK / 8PSK	GFSK
Duty Cycle	1/8	1/8 to 2/8	1/8 to 2/8	
Transmitter Frequency Range (MHz)	824 - 849 1850 - 1910	824 - 849 1850 - 1910	824 - 849 1850 - 1910	2402-2480

Outside of USA and Canada, the transmitter of the device is capable of operating also in 900 / 1800 MHz bands, which are not part of this filing.

1.4 Picture of Device

HWID: 0572, flip closed

HWID: 0572, flip open

HWID: 0573, flip closed

HWID: 0573, flip open

2. TEST CONDITIONS

2.1 Temperature and Humidity

Ambient temperature (°C):	22.0 to 23.0
Ambient humidity (RH %):	30 to 40

2.2 Test Signal, Frequencies, and Output Power

The transmitter of the device was put into operation by using a call tester. Communications between the device and the call tester were established by air link.

For all tests the device output power was set to maximum power level; a fully charged battery was used for every test sequence.

The measurements were performed on low, middle and high channels.

3. DESCRIPTION OF THE TEST EQUIPMENT

3.1 Measurement system and components

The measurements were performed using an automated near-field scanning system, DASY 4, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland.
The following table lists calibration dates of SPEAG components:

Test Equipment	Serial Number	Calibration interval	Calibration expiry
DAE V1	388	12 months	2007-01
E-field Probe ER3DV6	2333	12 months	2007-01
H-field Probe H3DV6	6053	12 months	2007-01
Dipole Validation Kit, CD835V3	1004	24 months	2007-02
Dipole Validation Kit, CD1880V3	1003	24 months	2007-02

Additional test equipment used in testing and validation:

Test Equipment	Model	Serial Number	Calibration interval	Calibration expiry
Signal Generator	8657B	3630U08114	12 months	2007-01
Amplifier	5S1G4	306024	12 months	2006-07
Power Meter	E4416A	GB41291465	12 months	2007-01
Power Sensor	FSH-Z1	100411	12 months	2007-01
Radio Communication Tester	CMU 200	103293	-	-

3.1.1 Isotropic E-field probe ER3DV6, SN: 2333

Construction	One dipole parallel, two dipoles normal to probe axis Built-in shielding against static charges PEEK enclosure material
Frequency	In air 100 MHz to >6 GHz; Linearity: ± 0.2 dB (100 MHz to 3 GHz)
Directivity	± 0.2 dB in air (rotation around probe axis) ± 0.4 dB in air (rotation normal to probe axis)
Dynamic Range	2 V/m to > 1000 V/m; Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm Tip length: 16 mm Body diameter: 12 mm Tip diameter: 8 mm Distance from probe tip to nearest point of dipole: 1.25 mm
Application	Generel near-field measurements up to 6 GHz Field component measurements Fast automatic scanning in phantoms

3.1.2 Isotropic H-field probe H3DV6, SN: 6053

Construction	Three concentric loop sensors with 3.8 mm loop diameters Resistively loaded detector diodes for linear response Built-in shielding against static charges PEEK enclosure material
Frequency	200 MHz to 3 GHz; Output linearized (absolute accuracy ±6.0%, k=2)
Directivity	± 0.25 dB (spherical isotropy error)
Dynamic Range	10 mA/m to 2 A/m at 1 GHz
Dimensions	Overall length: 330 mm Tip length: 40 mm Body diameter: 12 mm Tip diameter: 6 mm Distance from probe tip to nearest point of dipole: 1.1 mm
Application	Generel magnetic near-field measurements up to 3 GHz Field component measurements, surface current measurements Measurements in air or liquids, low interaction

3.2 WD positioner

The WD positioner and Test Arch is manufactured by Speag (http://www.dasy4.com/hac). Test arch is used for all tests i.e. for both validation testing and device testing. The positioner and test arch conforms to the requirements of ANSI C63.19.

The SPEAG device holder (see Section 5.1) was used to position the test device in all tests whilst a tripod was used to position the validation dipoles in the test arch.

3.2.1 Validation of the System

The manufacturer calibrates the probes annually. Validation measurements are made regularly using the dipole validation kit. The power level used by manufacturer in dipole calibration is supplied to the dipole antenna. The antenna is scanned at 1.0cm distance between top surface of the dipole and calibration point of the probe.

System Validation, H-field and E-field

Frequency / MHz	Date	Description	H-field	E-field
835MHz		Reference result ± 10% window	0.439 0.395 – 0.483	162.1 145.9 – 178.3
	2006-04-26 to 2006-04-27	Dipole, SN: 1004	0.434	168.2
1880MHz		Reference result ± 10% window	0.444 0.400 – 0.488	133.9 134.8 – 147.3
	2006-04-26 to 2006-04-27	Dipole, SN: 1004	0.432	132.7

Plots of the system checking scans are given in Appendix A.

4. DESCRIPTION OF THE TEST PROCEDURE

4.1 Test Arch and Device Holder

The test device was placed in the Device Holder (illustrated below) that is supplied by SPEAG. Using this positioner the tested device is positioned under Test Arch.

Device holder and Test Arch supplied by SPEAG

4.2 Test Positions

4.2.1 Scan area centered at the speaker output

The device was positioned such that Device Reference level was touching the bottom of the Test Arch. The scan is centered at the speaker output by aligning the speaker output with the intersection of the Test Arch's middle bar and dielectric wire.

Photo of the device positioned under Test Arch

4.2.2 Scan area centered at the maximum magnetic T-coil coupling

Scanning centered at the maximum magnetic T-coil coupling was not applicable for the tested device.

4.3 Scan Procedures

Near field scans of 5cm x 5cm were used for determination of the field distribution. Measurement plane distance from WD reference plane is 1cm. Scans were performed for both E- and H-field using appropriate probe. DASY software divides detected values into 3 x 3 subgrids as described in the C63.19 standard.

4.4 Probe Modulation Factor

All raw measurements in DASY4 system are RMS values. The measurement software then applies Probe Modulation Factor (PMF) to convert readings to "slot averaged" peak values as described in the C63.19 standard. This Probe Modulation Factor was assessed as described in standard with following results:

Freq./ MHz	E-field probe, SN: 2333		H-field probe, SN: 6053		E-field PMF	H-field PMF
	CW	GSM	CW	GSM		
835	106.1	37.26	0.4871	0.1837	2.85	2.65
1880	149.3	51.98	0.4981	0.2366	2.87	2.11

4.5 Slot Averaged Calculation Method

The slot-averaged values were calculated using modulation response conversion factor of sqrt(8.3) (in linear units).

4.6 Sub-grid Exclusion

The measurement grid defined in C63.19 consists of 9 evenly sized blocks, which are used to define permissible exclusion areas. For both E- and H-field measurements three contiguous blocks may be excluded from the measurements except center block may never be excluded. There must be 4 blocks left that are common for both E- and H-field measurements, so maximum of 5 different blocks can be excluded (e.g. 3 blocks excluded from E-field and 2 blocks from H-field).

4.7 Category Limits

From remaining maximum values after exclusion process, Hearing Aid M-category is defined according to the category limits of C63.19.

Category Limits for RF-parameters <960MHz

Category	AWF (dB)	Limits for E-Field Emissions (V/m)	Limits for H-Field Emissions (A/m)
M1	0	631.0 - 1122.0	1.91 - 3.39
	-5	473 - 841.4	1.43 - 2.54
M2	0	354.8 - 631.0	1.07 - 1.91
	-5	266.1 - 473.2	0.80 - 1.43
M3	0	199.5 - 354.8	0.60 - 1.07
	-5	**149.6 - 266.1**	**0.45 - 0.80**
M4	0	<199.5	<0.60
	-5	<149.6	<0.45

Category Limits for RF-parameters >960MHz

Category	AWF (dB)	Limits for E-Field Emissions (V/m)	Limits for H-Field Emissions (A/m)
M1	0	199.5 - 354.8	0.6 - 1.07
	-5	149.6 - 266.1	0.45 - 0.8
M2	0	112.2 - 199.5	0.34 - 0.6
	-5	84.1 - 149.6	0.25 - 0.45
M3	0	63.1 - 112.2	0.19 - 0.34
	-5	**47.3 - 84.1**	**0.15 - 0.25**
M4	0	<63.1	<0.19
	-5	<47.3	<0.15

5. MEASUREMENT UNCERTAINTY

Source of Uncertainty	Tolerance ±%	Probability Distribution	Div.	ci E	ci H	Standard Uncertainty ±%, E	Standard Uncertainty ±%, H	Remark
Measurement System								
Probe Calibration	5.1	N	1	1	1	5.1	5.1	
Axial Isotropy	4.7	R	√3	1	1	2.7	2.7	
Sensor Displacement	16.5	R	√3	1	0.145	9.5	1.4	
Boundary Effect	2.4	R	√3	1	1	1.4	1.4	
Linearity	4.7	R	√3	1	1	2.7	2.7	SAR
Scaling to Peak Envelope Power	2.0	R	√3	1	1	1.2	1.2	
System Detection Limit	1.0	R	√3	1	1	0.6	0.6	
Readout Electronics	0.3	N	1	1	1	0.3	0.3	SAR
Response Time	0.8	R	√3	1	1	0.5	0.5	
Integration Time	2.6	R	√3	1	1	1.5	1.5	SAR
RF Ambient Conditions	3.0	R	√3	1	1	1.7	1.7	SAR
RF Reflections	12.0	R	√3	1	1	6.9	6.9	
Probe Positioner	1.2	R	√3	1	0.67	0.7	0.5	
Probe Positioning	4.7	R	√3	1	0.67	2.7	1.8	
Extrapolation and Interpolation	1.0	R	√3	1	1	0.6	0.6	SAR
Test Sample Related								
Decice Positioning Vertical	4.7	R	√3	1	0.67	2.7	1.8	
Device Positioning Lateral	1.0	R	√3	1	1	0.6	0.6	
Device Holder and Phantom	2.4	R	√3	1	1	1.4	1.4	
Power Drift	5.0	R	√3	1	1	2.9	2.9	SAR
Phantom and Setup Related								
Phantom Thickness	2.4	R	√3	1	0.67	1.4	0.9	
Combined Standard Uncertainty						**14.7**	**10.9**	
Expanded Uncertainty on Power						**29.4**	**21.8**	
Expanded Uncertainty on Field						**14.7**	**10.9**	

6. RESULTS

The calculated maximum field values for the test device are tabulated below:

GSM850, E and H RF emissions results

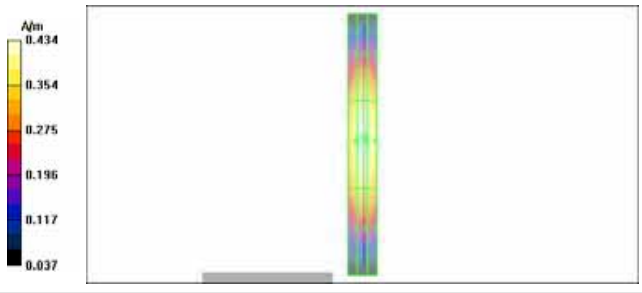
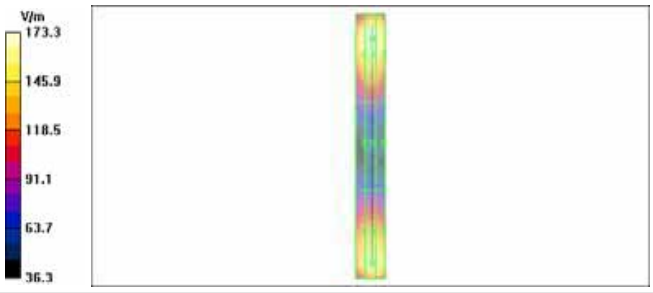
HWID	Mode	Flip option	Test configuration	Ch 128 824.2MHz	Ch 190 836.6MHz	Ch 251 848.8MHz
0572	GSM850	Flip open	E-field (V/M)	247.8	246.7	**260.9**
			H-field (A/m)	0.476	0.491	**0.539**
			Category	M3 (-5dB)	M3 (-5dB)	M3 (-5dB)
0573	GSM850	Flip open	E-field (V/M)	247.4	249.4	**263.8**
			H-field (A/m)	0.465	0.479	**0.514**
			Category	M3 (-5dB)	M3 (-5dB)	M3 (-5dB)

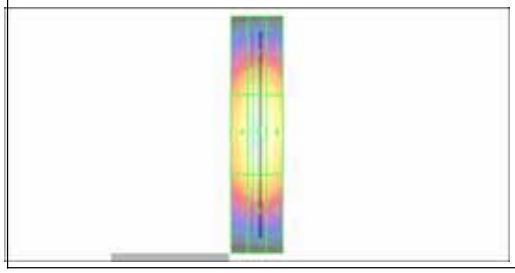
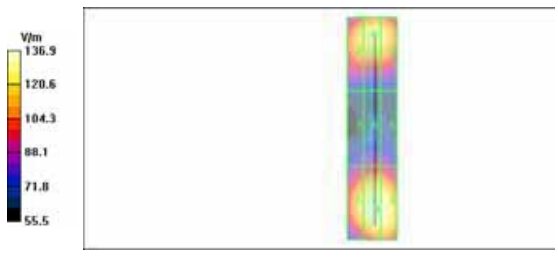
GSM1900, E and H RF emissions results

HWID	Mode	Flip option	Test configuration	Ch 512 1850.2MHz	Ch 661 1880.0MHz	Ch 810 1909.8MHz
0572	GSM1900	Flip open	E-field (V/M)	**78.7**	72.4	73.0
			H-field (A/m)	0.166	0.168	**0.183**
			Category	M3 (-5dB)	M3 (-5dB)	M3 (-5dB)
0573	GSM1900	Flip open	E-field (V/M)	**68.2**	64.9	67.9
			H-field (A/m)	0.138	0.136	**0.153**
			Category	M3 (-5dB)	M3 (-5dB)	M3 (-5dB)

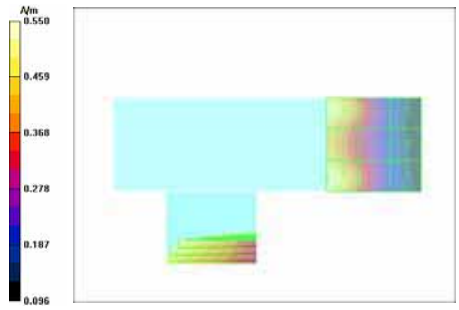
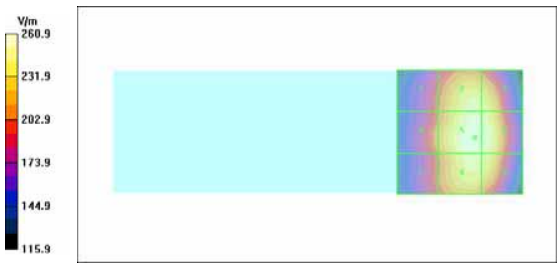
Plots of the maximum measurement scans are given in Appendix B.

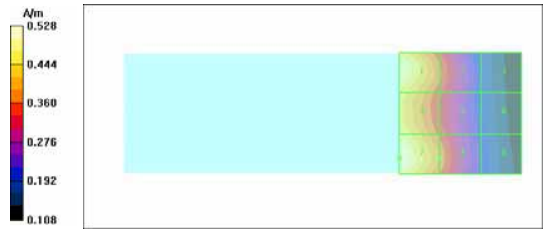
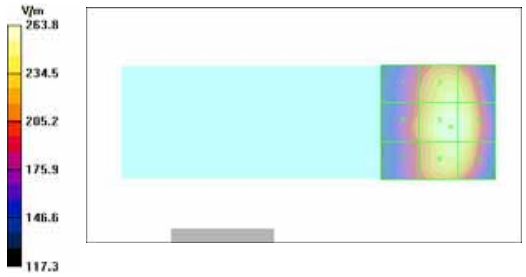
APPENDIX A: SYSTEM VALIDATION SCANS

Date/Time: 26.04.2006 10:23:28 Test Laboratory: TCC Nokia, Salo_A Laboratory **Type: D835V3;Serial: 1004** **Program Name: H-field Dipole**	Date/Time: 27.04.2006 14:54:55 Test Laboratory: TCC Nokia, Salo_A Laboratory **Type: D835V3; Serial: 1004** **Program Name: E-field Dipole**
Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1 Medium: Air Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3 Phantom section: H Device Section	Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1 Medium: Air Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m^3 Phantom section: E Dipole Section
DASY4 Configuration: - Probe: H3DV6 - SN6053; ; Calibrated: 24.01.2006 - Sensor-Surface: (Fix Surface) - Electronics: DAE3 Sn388; Calibrated: 19.01.2006 - Phantom: HAC Test Arch; Type: SD HAC P01 BA; - Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170	DASY4 Configuration: - Probe: ER3DV6 - SN2333; ConvF(1, 1, 1); Calibrated: 24.01.2006 - Sensor-Surface: (Fix Surface) - Electronics: DAE3 Sn388; Calibrated: 07.01.2005 - Phantom: HAC Test Arch; Type: SD HAC P01 BA; - Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170
H Scan - 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1): Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 0.434 A/m Probe Modulation Factor = 1.00 Reference Value = 0.496 A/m; Power Drift = 0.003 dB	**E Scan 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1):** Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 173.3 V/m Probe Modulation Factor = 1.00 Reference Value = 108.4 V/m; Power Drift = -0.019 dB
Peak H-field in A/m Grid 1 **0.365** | Grid 2 **0.390** | Grid 3 **0.378** Grid 4 **0.406** | Grid 5 **0.434** | Grid 6 **0.423** Grid 7 **0.348** | Grid 8 **0.371** | Grid 9 **0.361**	Peak E-field in V/m Grid 1 **166.0** | Grid 2 **173.3** | Grid 3 **171.2** Grid 4 **90.7** | Grid 5 **94.5** | Grid 6 **92.8** Grid 7 **154.9** | Grid 8 **163.1** | Grid 9 **161.8**
	

Date/Time: 26.04.2006 10:54:12 Test Laboratory: TCC Nokia, Salo_A Laboratory **Type: CD1880V3;Serial: 1003** **Program Name: H-field Dipole**	Date/Time: 27.04.2006 15:22:34 Test Laboratory: TCC Nokia, Salo_A Laboratory **Type: CD1880V3; Serial: 1003** **Program Name: E-field Dipole**
Communication System: CW; Frequency: 1880 MHz;Duty Cycle: 1:1 Medium: Air Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3 Phantom section: H Device Section	Communication System: CW; Frequency: 1880 MHz;Duty Cycle: 1:1 Medium: Air Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m^3 Phantom section: E Dipole Section
DASY4 Configuration: - Probe: H3DV6 - SN6053; ; Calibrated: 24.01.2006 - Sensor-Surface: (Fix Surface) - Electronics: DAE3 Sn388; Calibrated: 19.01.2006 - Phantom: HAC Test Arch; Type: SD HAC P01 BA; - Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170	DASY4 Configuration: - Probe: ER3DV6 - SN2333; ConvF(1, 1, 1); Calibrated: 24.01.2006 - Sensor-Surface: (Fix Surface) - Electronics: DAE3 Sn388; Calibrated: 07.01.2005 - Phantom: HAC Test Arch; Type: SD HAC P01 BA; - Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170
H Scan - 10mm above CD1880 Dipole/Hearing Aid Compatibility Test (41x181x1): Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 0.432 A/m Probe Modulation Factor = 1.00 Reference Value = 0.488 A/m; Power Drift = 0.005 dB	**E Scan - 10mm above CD 1880 Dipole/Hearing Aid Compatibility Test (41x181x1):** Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 136.9 V/m Probe Modulation Factor = 1.00 Reference Value = 142.5 V/m; Power Drift = 0.000 dB
Peak H-field in A/m Grid 1 **0.370** / Grid 2 **0.395** / Grid 3 **0.387** Grid 4 **0.406** / Grid 5 **0.432** / Grid 6 **0.423** Grid 7 **0.361** / Grid 8 **0.384** / Grid 9 **0.373**	Peak E-field in V/m Grid 1 **127.2** / Grid 1 **136.9** / Grid 3 **136.6** Grid 4 **88.8** / Grid 5 **93.5** / Grid 6 **92.4** Grid 7 **123.7** / Grid 8 **128.4** / Grid 9 **127.3**
	

APPENDIX B: MEASUREMENT SCANS

Date/Time: 26.04.2006 14:07:12 Test Laboratory: TCC Nokia, Salo_A Laboratory **Type: RM-126; Serial: 004400/85/172494/6, HWID: 0572** **Program Name: HAC H Device**	Date/Time: 28.04.2006 10:33:43 Test Laboratory: TCC Nokia, Salo_A Laboratory **Type: RM-126;Serial: 004400/85/172494/6, HWID: 0572** **Program Name: HAC E Device**
Communication System: GSM850; Frequency: 848.8 MHz;Duty Cycle: 1:7 Medium: Air Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3 Phantom section: H Device Section	Communication System: GSM850; Frequency: 848.8 MHz;Duty Cycle: 1:8.1 Medium: Air Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m^3 Phantom section: E Device Section
DASY4 Configuration: - Probe: H3DV6 - SN6053; ; Calibrated: 24.01.2006 - Sensor-Surface: (Fix Surface) - Electronics: DAE3 Sn388; Calibrated: 19.01.2006 - Phantom: HAC Test Arch; Type: SD HAC P01 BA; - Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170	DASY4 Configuration: - Probe: ER3DV6 - SN2333; ConvF(1, 1, 1); Calibrated: 24.01.2006 - Sensor-Surface: (Fix Surface) - Electronics: DAE3 Sn388; Calibrated: 19.01.2006 - Phantom: HAC Test Arch; Type: SD HAC P01 BA; - Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170
H Scan 10mm above Device Reference/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 0.550 A/m Probe Modulation Factor = 2.65 Reference Value = 0.101 A/m; Power Drift = -0.095 dB	**E Scan 10mm above Device Reference /Hearing Aid Compatibility Test (101x101x1):** Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 260.9 V/m Probe Modulation Factor = 2.85 Reference Value = 95.7 V/m; Power Drift = 0.008 dB
Peak H-field in A/m Grid 1 **0.539** / Grid 2 **0.392** / Grid 3 **0.200** Grid 4 **0.484** / Grid 5 **0.346** / Grid 6 **0.199** Grid 7 **0.550** / Grid 8 **0.393** / Grid 9 **0.207**	Peak E-field in V/m Grid 1 **201.4** / Grid 2 **249.7** / Grid 3 **247.5** Grid 4 **213.4** / Grid 5 **260.9** / Grid 6 **258.8** Grid 7 **203.9** / Grid 8 **251.3** / Grid 9 **249.2**
	

Date/Time: 27.04.2006 12:46:31 Test Laboratory: TCC Nokia, Salo_A Laboratory **Type: RM-126; Serial: 004400/85/172399/7, HWID: 0573** **Program Name: HAC H Device**	Date/Time: 28.04.2006 10:56:18 Test Laboratory: TCC Nokia, Salo_A Laboratory **Type: RM-126; Serial: 004400/85/172399/7, HWID: 0573** **Program Name: HAC E Device**
Communication System: GSM850; Frequency: 848.8 MHz;Duty Cycle: 1:7 Medium: Air Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3 Phantom section: H Device Section	Communication System: GSM850; Frequency: 848.8 MHz;Duty Cycle: 1:8.1 Medium: Air Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m^3 Phantom section: E Device Section
DASY4 Configuration: - Probe: H3DV6 - SN6053; ; Calibrated: 24.01.2006 - Sensor-Surface: (Fix Surface) - Electronics: DAE3 Sn388; Calibrated: 19.01.2006 - Phantom: HAC Test Arch; Type: SD HAC P01 BA; - Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170	DASY4 Configuration: - Probe: ER3DV6 - SN2333; ConvF(1, 1, 1); Calibrated: 24.01.2006 - Sensor-Surface: (Fix Surface) - Electronics: DAE3 Sn388; Calibrated: 19.01.2006 - Phantom: HAC Test Arch; Type: SD HAC P01 BA; - Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170
H Scan 10mm above Device Reference/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 0.528 A/m Probe Modulation Factor = 2.65 Reference Value = 0.102 A/m; Power Drift = -0.006 dB	**E Scan 10mm above Device Reference/Hearing Aid Compatibility Test (101x101x1):** Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 263.8 V/m Probe Modulation Factor = 2.85 Reference Value = 98.6 V/m; Power Drift = -0.125 dB
Peak H-field in A/m Grid 1 **0.514** / Grid 2 **0.366** / Grid 3 **0.203** Grid 4 **0.481** / Grid 5 **0.352** / Grid 6 **0.208** Grid 7 **0.528** / Grid 8 **0.383** / Grid 9 **0.215**	Peak E-field in V/m Grid 1 **204.9** / Grid 2 **251.8** / Grid 3 **249.8** Grid 4 **216.1** / Grid 5 **263.8** / Grid 6 **262.1** Grid 7 **205.3** / Grid 8 **252.8** / Grid 9 **251.9**
	

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<td>Date/Time: 26.04.2006 14:45:10
Test Laboratory: TCC Nokia, Salo_A Laboratory
Type: RM-126;Serial: 004400/85/172494/6, HWID: 0572
Program Name: HAC H Device</td>
<td>Date/Time: 28.04.2006 13:58:34
Test Laboratory: TCC Nokia, Salo_A Laboratory
Type: RM-126;Serial: 004400/85/172494/6, HWID: 0572
Program Name: HAC E Device</td>
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<tr>
<td>Communication System:
DCS 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:4.4
Medium: Air Medium parameters used:
σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m³
Phantom section: H Device Section</td>
<td>Communication System:
DCS 1900; Frequency: 1850.2 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used:
σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m³
Phantom section: E Device Section</td>
</tr>
<tr>
<td>DASY4 Configuration:
- Probe: H3DV6 - SN6053; ; Calibrated: 24.01.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn388; Calibrated: 19.01.2006
- Phantom: HAC Test Arch; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170</td>
<td>DASY4 Configuration:
- Probe: ER3DV6 - SN2333; ConvF(1, 1, 1); Calibrated: 24.01.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn388; Calibrated: 19.01.2006
- Phantom: HAC Test Arch; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170</td>
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<tr>
<td>H Scan 10mm above Device Reference/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.194 A/m
Probe Modulation Factor = 2.10
Reference Value = 0.068 A/m; Power Drift = -0.039 dB</td>
<td>E Scan 10mm above Device Reference/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 85.8 V/m
Probe Modulation Factor = 2.88
Reference Value = 19.4 V/m; Power Drift = -0.056 dB</td>
</tr>
<tr>
<td>Peak H-field in A/m
<table>
<tr><td>Grid 1
0.166</td><td>Grid 2
0.165</td><td>Grid 3
0.129</td></tr>
<tr><td>Grid 4
0.169</td><td>Grid 5
0.163</td><td>Grid 6
0.125</td></tr>
<tr><td>Grid 7
0.194</td><td>Grid 8
0.182</td><td>Grid 9
0.118</td></tr>
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<td>Peak E-field in V/m
<table>
<tr><td>Grid 1
66.4</td><td>Grid 2
58.0</td><td>Grid 3
61.8</td></tr>
<tr><td>Grid 4
65.1</td><td>Grid 5
78.7</td><td>Grid 6
80.5</td></tr>
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60.4</td><td>Grid 8
85.7</td><td>Grid 9
85.8</td></tr>
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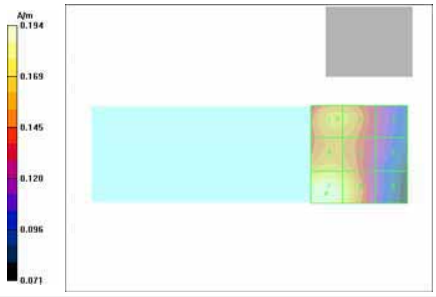
<td> 
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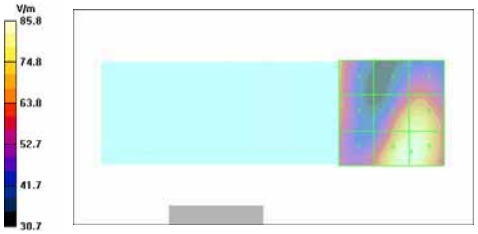
<td> 
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Test Laboratory: TCC Nokia, Salo_A Laboratory
Type: RM-126;Serial: 004400/85/172494/6, HWID: 0572
Program Name: HAC H Device</td>
<td>Date/Time: 28.04.2006 14:06:56
Test Laboratory: TCC Nokia, Salo_A Laboratory
Type: RM-126;Serial: 004400/85/172494/6, HWID: 0572
Program Name: HAC E Device</td>
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<td>Communication System:
DCS 1900; Frequency: 1909.8 MHz;Duty Cycle: 1:4.4
Medium: Air Medium parameters used:
σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m³
Phantom section: H Device Section</td>
<td>Communication System:
DCS 1900; Frequency: 1909.8 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used:
σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m³
Phantom section: E Device Section</td>
</tr>
<tr>
<td>DASY4 Configuration:
- Probe: H3DV6 - SN6053; ; Calibrated: 24.01.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn388; Calibrated: 19.01.2006
- Phantom: HAC Test Arch; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170</td>
<td>DASY4 Configuration:
- Probe: ER3DV6 - SN2333; ConvF(1, 1, 1); Calibrated: 24.01.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn388; Calibrated: 19.01.2006
- Phantom: HAC Test Arch; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170</td>
</tr>
<tr>
<td>H Scan 10mm above Device Reference/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.185 A/m
Probe Modulation Factor = 2.10
Reference Value = 0.068 A/m; Power Drift = 0.019 dB</td>
<td>E Scan 10mm above Device Reference/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 78.0 V/m
Probe Modulation Factor = 2.88
Reference Value = 16.6 V/m; Power Drift = 0.038 dB</td>
</tr>
<tr>
<td>Peak H-field in A/m
<table>
<tr><td>Grid 1
0.185</td><td>Grid 2
0.183</td><td>Grid 3
0.140</td></tr>
<tr><td>Grid 4
0.165</td><td>Grid 5
0.163</td><td>Grid 6
0.133</td></tr>
<tr><td>Grid 7
0.173</td><td>Grid 8
0.163</td><td>Grid 9
0.114</td></tr>
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<td>Peak E-field in V/m
<table>
<tr><td>Grid 1
72.4</td><td>Grid 2
52.7</td><td>Grid 3
56.9</td></tr>
<tr><td>Grid 4
66.8</td><td>Grid 5
70.7</td><td>Grid 6
73.0</td></tr>
<tr><td>Grid 7
55.6</td><td>Grid 8
77.9</td><td>Grid 9
78.0</td></tr>
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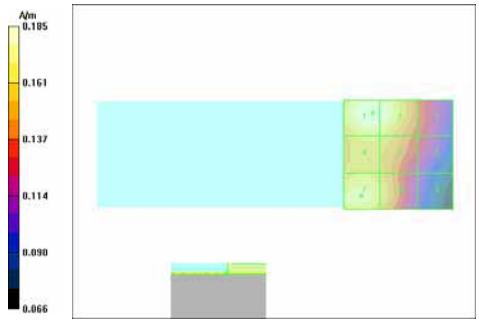
<td> 
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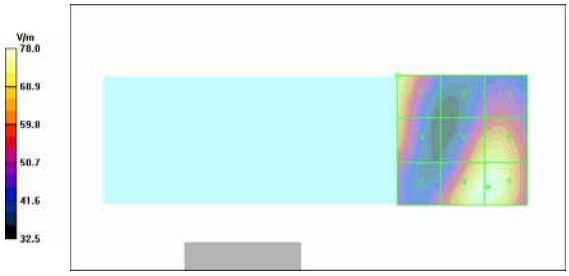
<td> 
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Test Laboratory: TCC Nokia, Salo_A Laboratory
Type: RM-126; Serial: 004400/85/172399/7, HWID: 0573
Program Name: HAC H Device</td>
<td>Date/Time: 28.04.2006 12:24:31
Test Laboratory: TCC Nokia, Salo_A Laboratory
Type: RM-126; Serial: 004400/85/172399/7, HWID: 0573
Program Name: HAC E Device</td>
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<td>Communication System:
DCS 1900; Frequency: 1850.2 MHz;Duty Cycle: 1:4.4
Medium: Air Medium parameters used:
σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3
Phantom section: H Device Section</td>
<td>Communication System:
DCS 1900; Frequency: 1850.2 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used:
σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: E Device Section</td>
</tr>
<tr>
<td>DASY4 Configuration:
- Probe: H3DV6 - SN6053; ; Calibrated: 24.01.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn388; Calibrated: 19.01.2006
- Phantom: HAC Test Arch; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170</td>
<td>DASY4 Configuration:
- Probe: ER3DV6 - SN2333; ConvF(1, 1, 1); Calibrated: 24.01.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn388; Calibrated: 19.01.2006
- Phantom: HAC Test Arch; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170</td>
</tr>
<tr>
<td>H Scan 10mm above Device Reference/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.156 A/m
Probe Modulation Factor = 2.10
Reference Value = 0.059 A/m; Power Drift = -0.049 dB</td>
<td>E Scan 10mm above Device Reference/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 70.8 V/m
Probe Modulation Factor = 2.88
Reference Value = 17.5 V/m; Power Drift = 0.014 dB</td>
</tr>
<tr>
<td>Peak H-field in A/m
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0.133</td><td>Grid 2
0.133</td><td>Grid 3
0.110</td></tr>
<tr><td>Grid 4
0.144</td><td>Grid 5
0.138</td><td>Grid 6
0.110</td></tr>
<tr><td>Grid 7
0.156</td><td>Grid 8
0.143</td><td>Grid 9
0.103</td></tr>
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<td>Peak E-field in V/m
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57.3</td><td>Grid 2
51.7</td><td>Grid 3
53.7</td></tr>
<tr><td>Grid 4
58.0</td><td>Grid 5
68.2</td><td>Grid 6
69.0</td></tr>
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53.4</td><td>Grid 8
70.8</td><td>Grid 9
70.8</td></tr>
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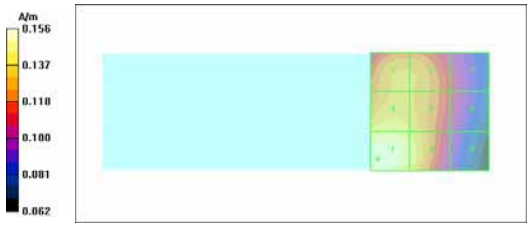
<td> 
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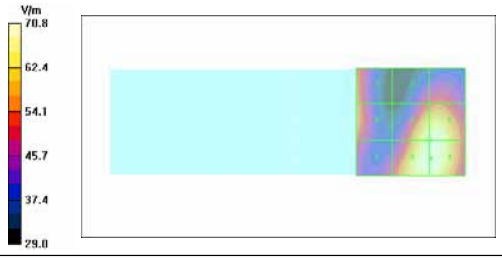
<td> 
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Test Laboratory: TCC Nokia, Salo_A Laboratory
Type: RM-126; Serial: 004400/85/172399/7, HWID: 0573
Program Name: HAC H Device</td>
<td>Date/Time: 28.04.2006 12:33:13
Test Laboratory: TCC Nokia, Salo_A Laboratory
Type: RM-126; Serial: 004400/85/172399/7, HWID: 0573
Program Name: HAC E Device</td>
</tr>
<tr>
<td>Communication System:
DCS 1900; Frequency: 1909.8 MHz;Duty Cycle: 1:4.4
Medium: Air Medium parameters used:
σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3
Phantom section: H Device Section</td>
<td>Communication System:
DCS 1900; Frequency: 1909.8 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used:
σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: E Device Section</td>
</tr>
<tr>
<td>DASY4 Configuration:
- Probe: H3DV6 - SN6053; ; Calibrated: 24.01.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn388; Calibrated: 19.01.2006
- Phantom: HAC Test Arch; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170</td>
<td>DASY4 Configuration:
- Probe: ER3DV6 - SN2333; ConvF(1, 1, 1); Calibrated: 24.01.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE3 Sn388; Calibrated: 19.01.2006
- Phantom: HAC Test Arch; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 170</td>
</tr>
<tr>
<td>H Scan 10mm above Device Reference/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.155 A/m
Probe Modulation Factor = 2.10
Reference Value = 0.063 A/m; Power Drift = -0.014 dB</td>
<td>E Scan 10mm above Device Reference/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 71.5 V/m
Probe Modulation Factor = 2.88
Reference Value = 16.6 V/m; Power Drift = 0.069 dB</td>
</tr>
<tr>
<td>Peak H-field in A/m
<table>
<tr><td>Grid 1
0.153</td><td>Grid 2
0.152</td><td>Grid 3
0.123</td></tr>
<tr><td>Grid 4
0.148</td><td>Grid 5
0.147</td><td>Grid 6
0.122</td></tr>
<tr><td>Grid 7
0.155</td><td>Grid 8
0.144</td><td>Grid 9
0.108</td></tr>
</table>
</td>
<td>Peak E-field in V/m
<table>
<tr><td>Grid 1
63.2</td><td>Grid 2
50.4</td><td>Grid 3
52.1</td></tr>
<tr><td>Grid 4
60.3</td><td>Grid 5
67.9</td><td>Grid 6
68.6</td></tr>
<tr><td>Grid 7
51.0</td><td>Grid 8
71.5</td><td>Grid 9
71.5</td></tr>
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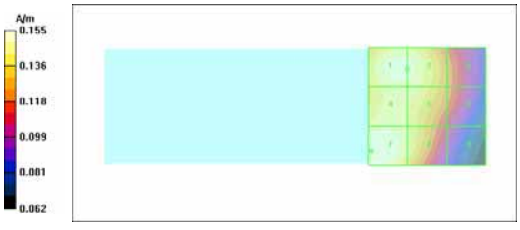
<td> 
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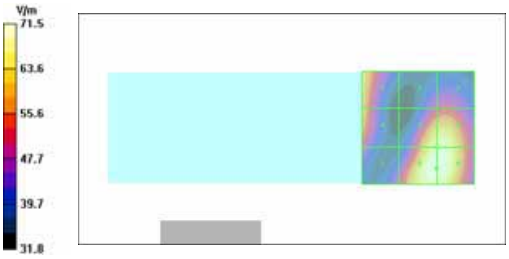
<td> 
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APPENDIX C: RELEVANT PAGES FROM PROBE CALIBRATION REPORT(S)

E-field probe ER3DV6, SN: 2333
H-field probe H3DV6, SN: 6053
See the next 7+6 pages.

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

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

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

Accreditation No.: SCS 108

Client **Nokia Salo TCC**

Certificate No: ER3-2333_Jan06

CALIBRATION CERTIFICATE

Object	ER3DV6 - SN:2333
Calibration procedure(s)	QA CAL-02.v4 Calibration procedure for E-field probes optimized for close near field evaluations in air
Calibration date:	January 24, 2006
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41495277	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41498087	3-May-05 (METAS, No. 251-00466)	May-06
Reference 3 dB Attenuator	SN: S5054 (3c)	11-Aug-05 (METAS, No. 251-00499)	Aug-06
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-05 (METAS, No. 251-00467)	May-06
Reference 30 dB Attenuator	SN: S5129 (30b)	11-Aug-05 (METAS, No. 251-00500)	Aug-06
Reference Probe ER3DV6	SN: 2328	3-Oct-05 (SPEAG, No. ER3-2328_Oct05)	Oct-06
DAE4	SN: 654	27-Oct-05 (SPEAG, No. DAE4-654_Oct05)	Oct-06

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

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

Issued: January 24, 2006

DASY - Parameters of Probe: ER3DV6 SN:2333

Sensitivity in Free Space [μV/(V/m)^2]		Diode Compression[A]	
NormX	**1.45** ± 10.1 % (k=2)	DCP X	**94** mV
NormY	**1.50** ± 10.1 % (k=2)	DCP Y	**94** mV
NormZ	**1.45** ± 10.1 % (k=2)	DCP Z	**99** mV

Frequency Correction

X	**0.0**
Y	**0.0**
Z	**0.0**

Sensor Offset (Probe Tip to Sensor Center)

X	**2.5** mm
Y	2.5 mm
Z	2.5 mm

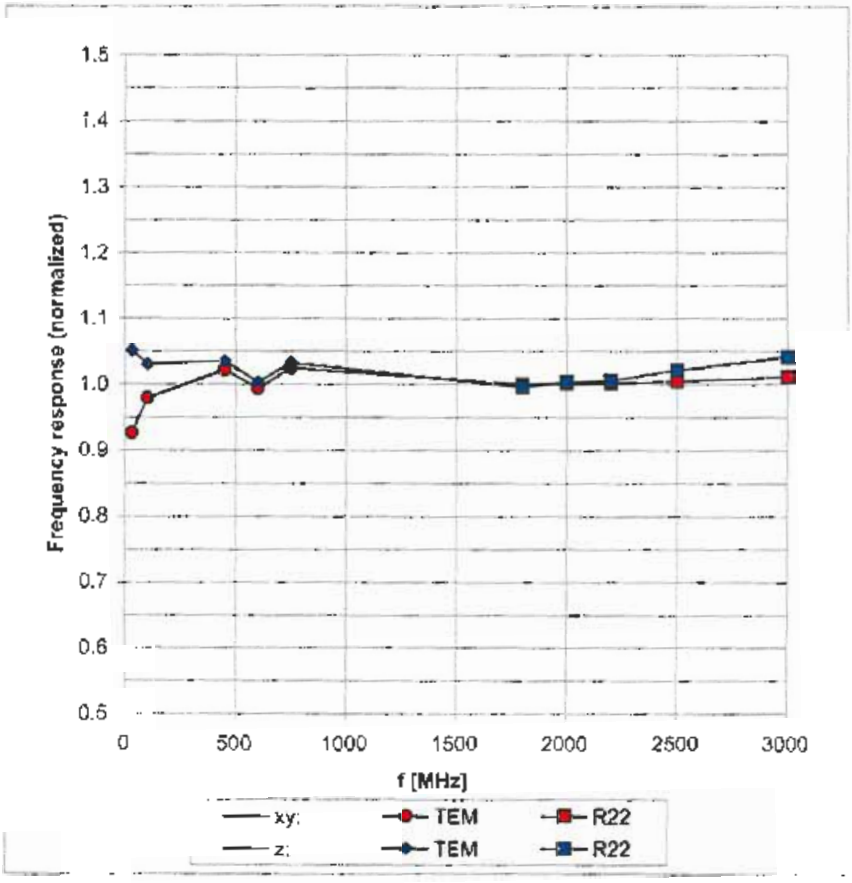
Connector Angle **319** °

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

[A] numerical linearization parameter: uncertainty not required

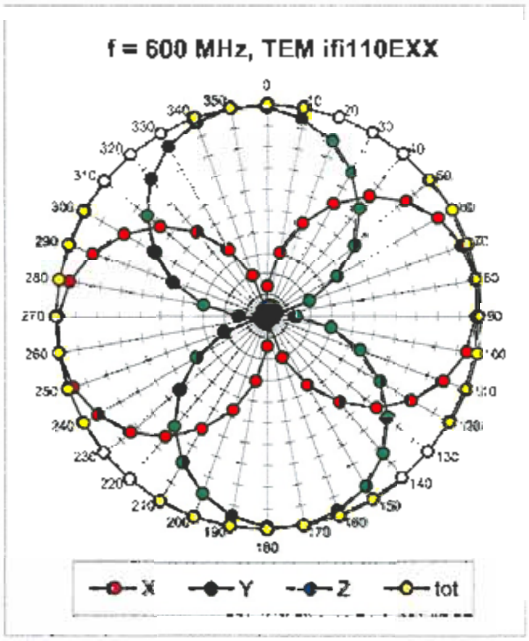
Frequency Response of E-Field

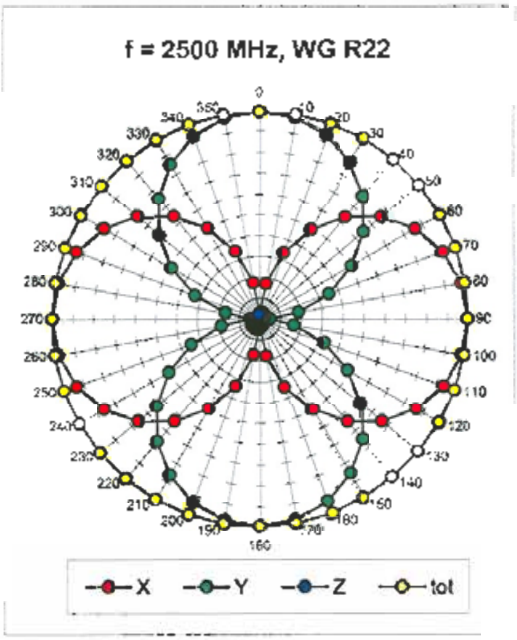
(TEM-Cell:ifi110 EXX, Waveguide R22)



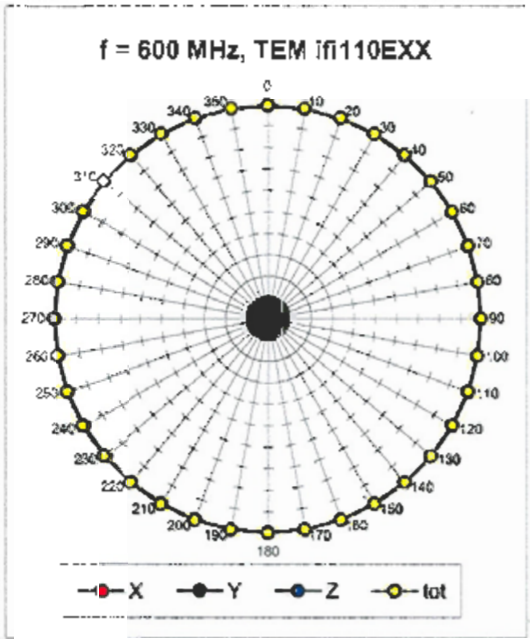
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

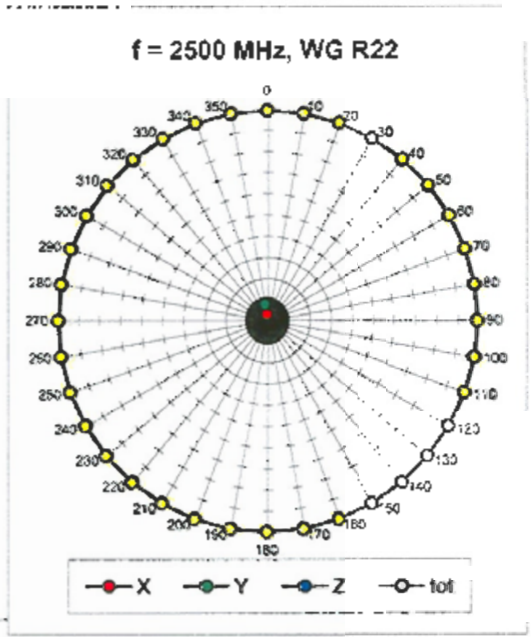
Receiving Pattern (ϕ), ϑ = 0°



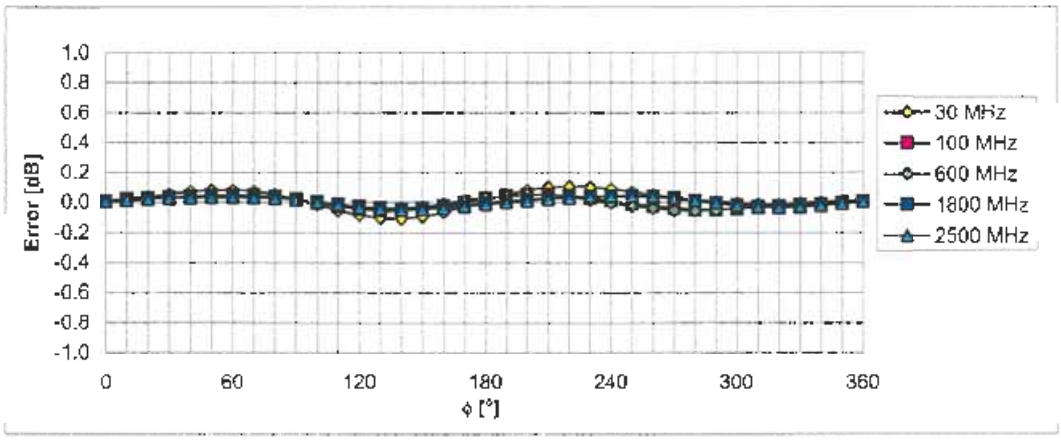


Receiving Pattern (ϕ), ϑ = 90°



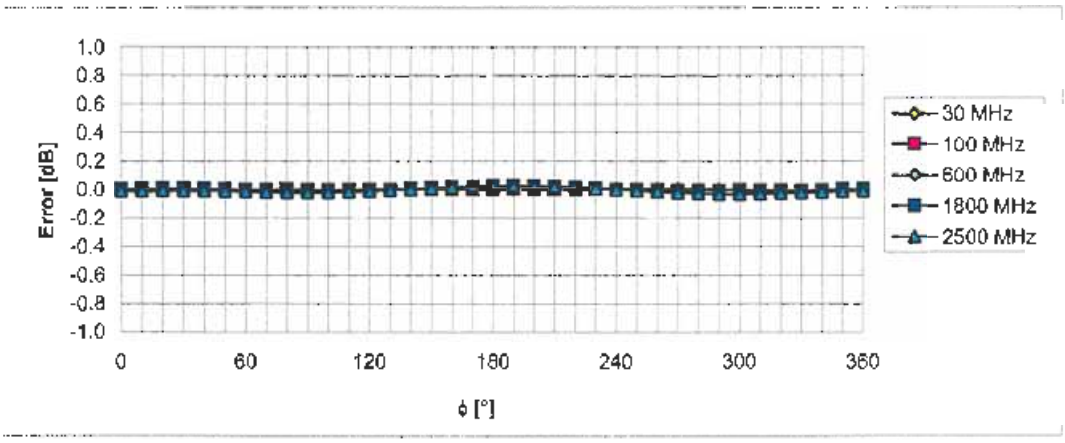


Receiving Pattern (ϕ), ϑ = 0°



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

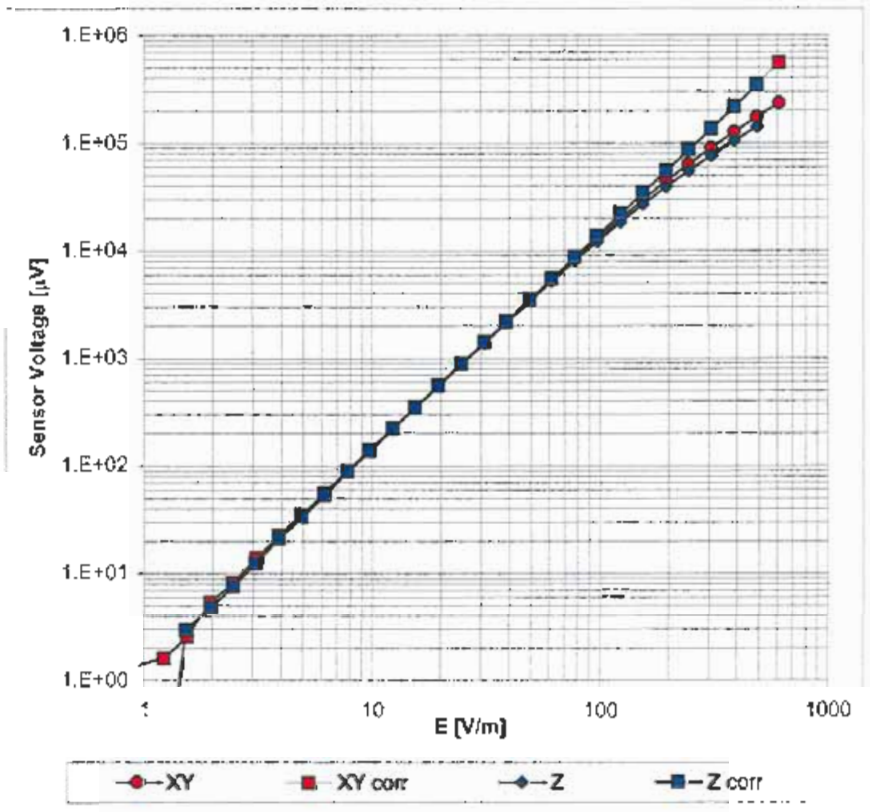
Receiving Pattern (ϕ), ϑ = 90°

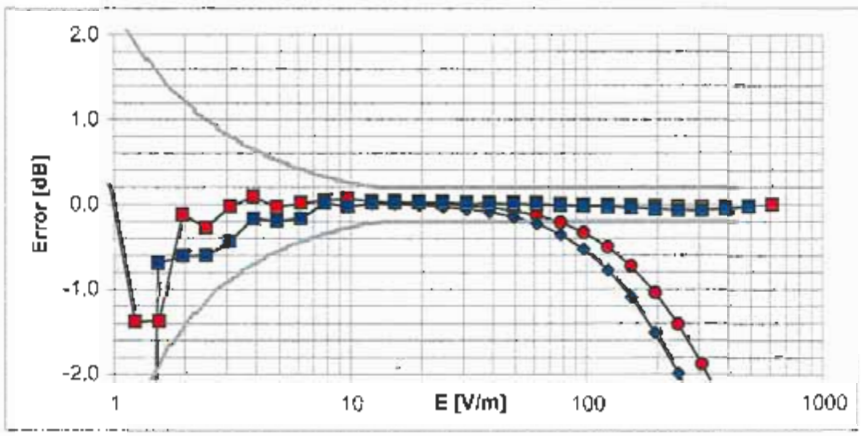


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(E-field)

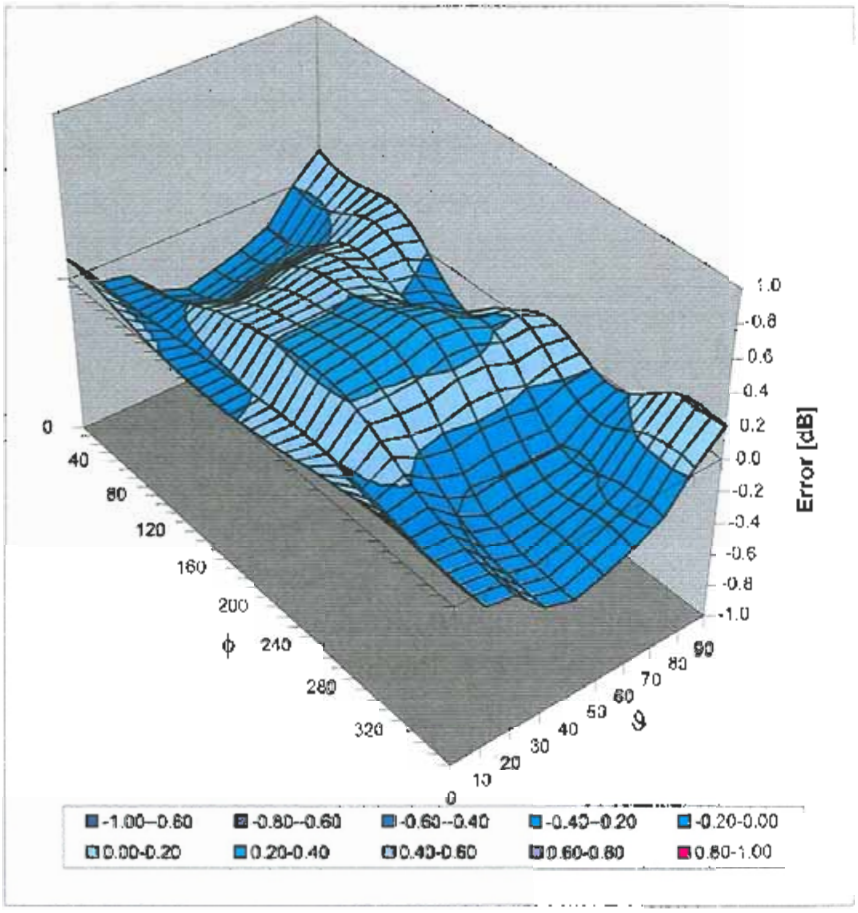
(Waveguide R22, f = 1800 MHz)





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

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



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

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

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

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

Accreditation No.: **SCS 108**

Client **Nokia Salo TCC**

Certificate No: **H3-6053_Jan06**

CALIBRATION CERTIFICATE

Object	H3DV6 - SN:6053
Calibration procedure(s)	QA CAL-03.v4 Calibration procedure for H-field probes optimized for close near field evaluations in air
Calibration date:	January 24, 2006
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

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

Issued: January 24, 2006

DASY - Parameters of Probe: H3DV6 SN:6053

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

	a0	a1	a2
X	**2.712E-03**	**-7.584E-5**	**-4.156E-5** ± 5.1 % (k=2)
Y	**2.563E-03**	**-1.967E-4**	**7.116E-5** ± 5.1 % (k=2)
Z	**2.915E-03**	**-3.764E-4**	**5.853E-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

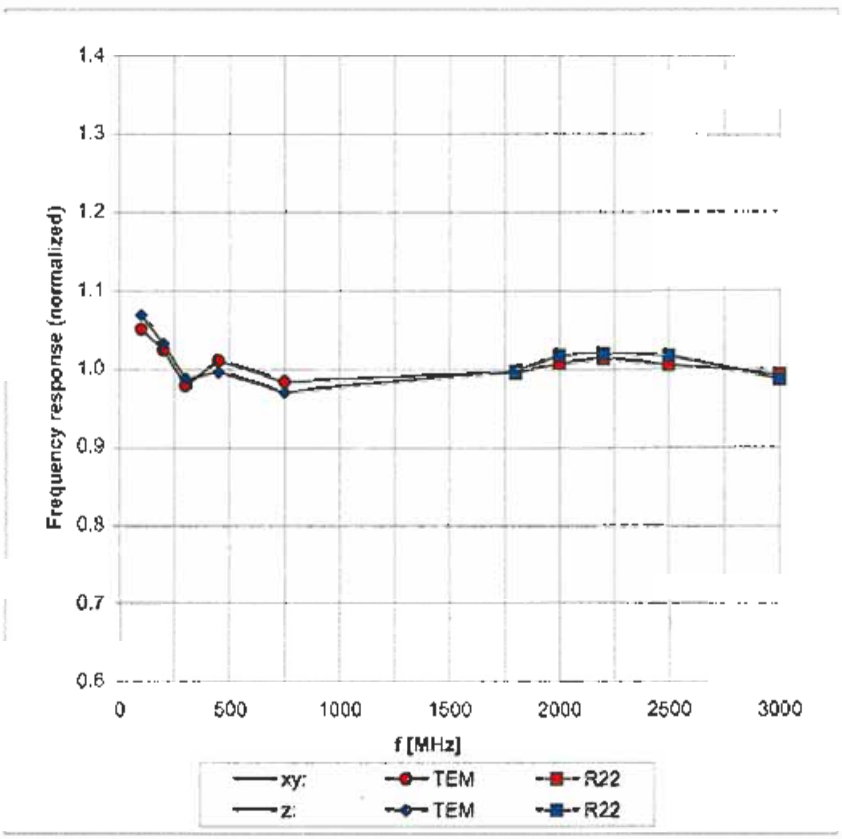
Connector Angle 33 °

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

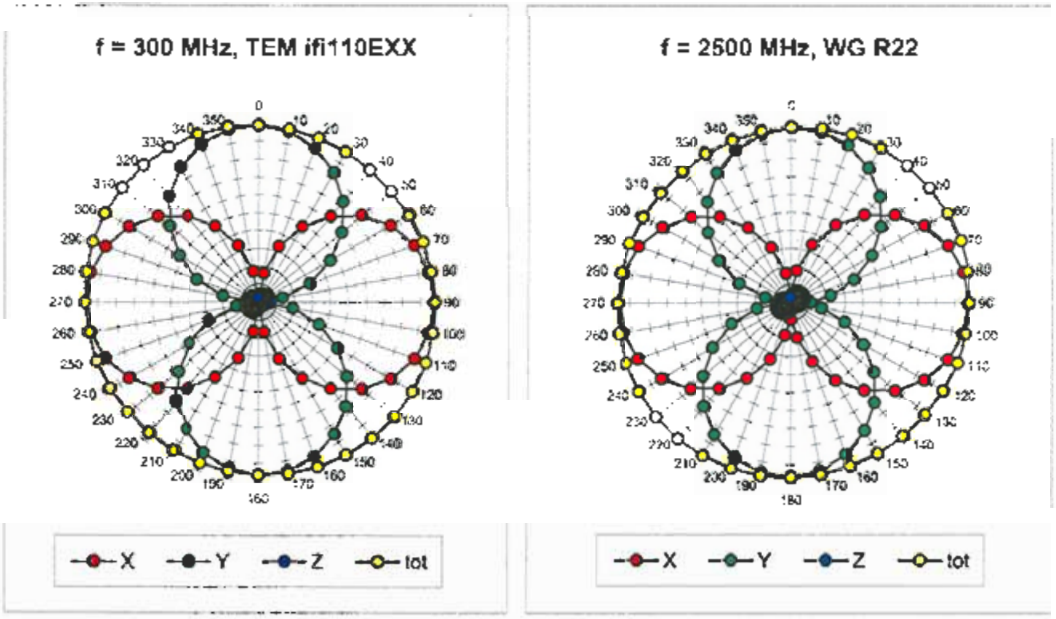
Frequency Response of H-Field

(TEM-Cell:ifi110, Waveguide R22)

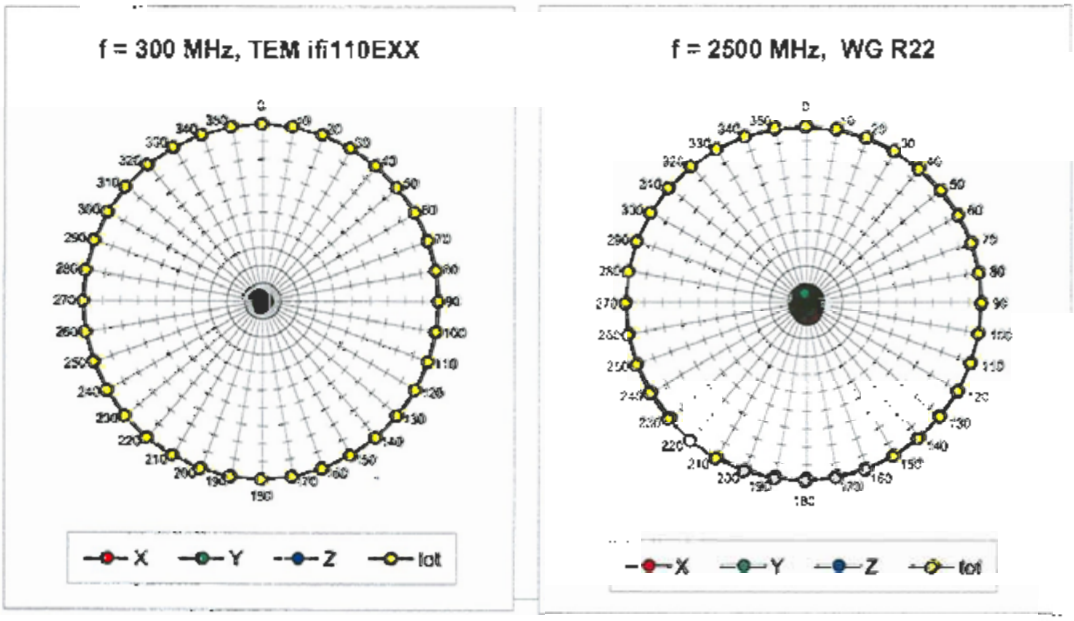


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

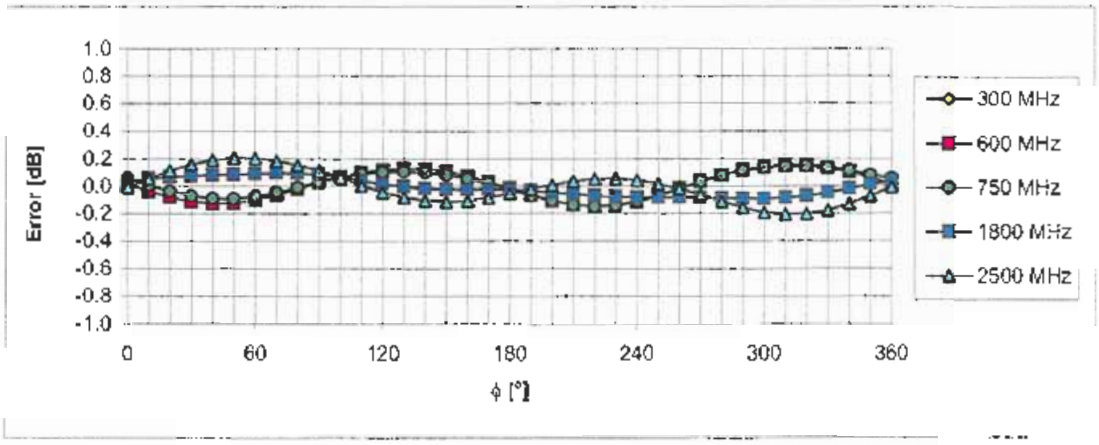
Receiving Pattern (ϕ), ϑ = 90°



Receiving Pattern (ϕ), ϑ = 0°

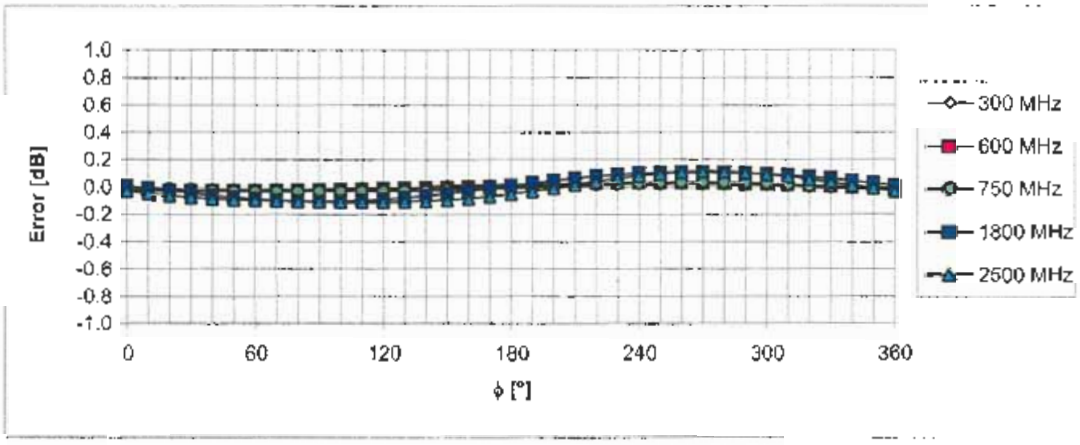


Receiving Pattern (ϕ), ϑ = 90°



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

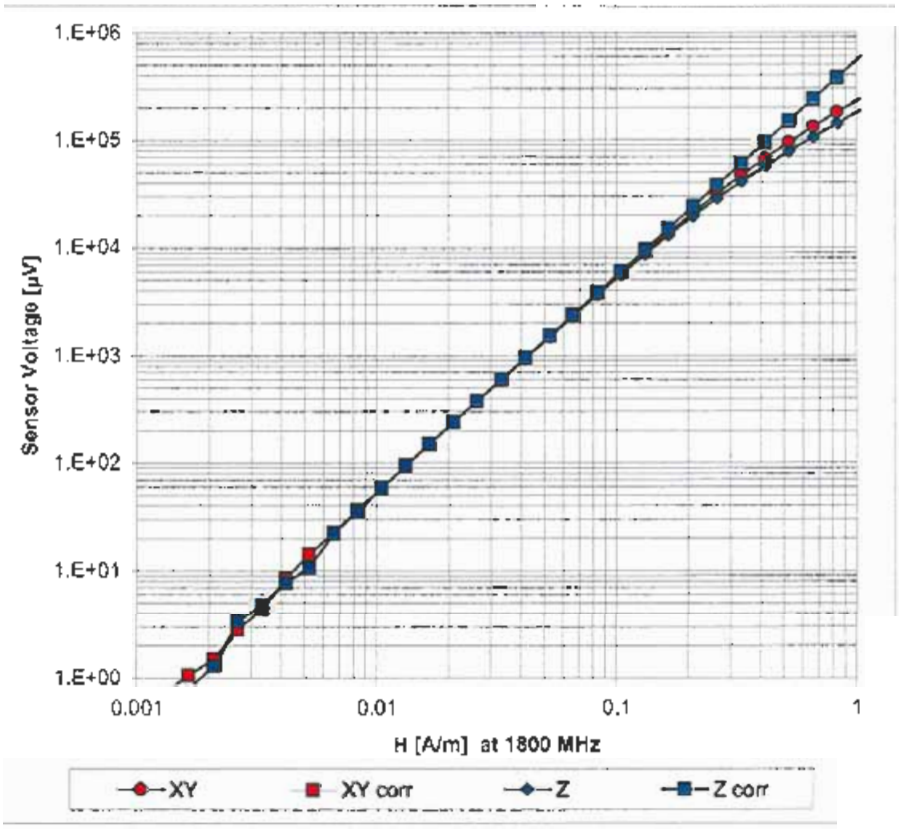
Receiving Pattern (ϕ), ϑ = 0°

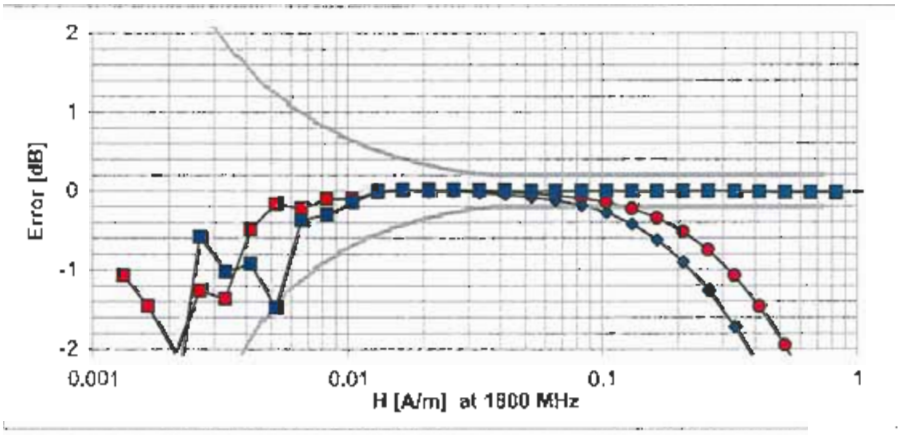


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(H-field)

(Waveguide R22, f = 1800 MHz)





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

APPENDIX D: RELEVANT PAGES FROM DIPOLE VALIDATION KIT REPORT(S)

835MHz dipole CD835V3, SN: 1004
1880MHz dipole CD1880V3, SN: 1003
See the next 5+5 pages.

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

Client NOKIA TCC SALO

Certificate No: **CD835V3-1004_Feb05**

CALIBRATION CERTIFICATE

Object	CD835V3 - SN: 1004
Calibration procedure(s)	QA CAL-20.v2 Calibration procedure for dipoles in air
Calibration date:	February, 23, 2005
Condition of the calibrated item	In Tolerance

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E442	GB37480704	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Power sensor HP 8481A	US37292783	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Reference 20 dB Attenuator	SN: 5086 (20g)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference Probe ER3DV6	SN 2328	06-Oct-04 (SPEAG, No. ER3-2328_Oct04)	Oct-05
DAE4	SN 601	07-Jan-05 (SPEAG, No. DAE4-601_Jan05)	Jan-06

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092312	10-Aug-03 (SPEAG, in house check Jan-04)	In house check: Oct-05
Power sensor HP 8481A	MY41093315	10-Aug-03 (SPEAG, in house check Jan-04)	In house check: Oct-05
RF generator Agilent E8251A	US41140111	4-Aug-03 (Agilent)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov-05
Probe H3DV6	SN: 6065	10-Oct-04 (SPEAG, No. H3-6065-Oct04)	Calibration, Oct-05

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

Issued: February 27, 2005

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

1 Measurement Conditions

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

DASY Version	DASY4	V4.5 B13
DASY PP Version	SEMCAD	V1.8 B144
Phantom	HAC Test Arch	SD HAC P01 BA, #1002
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 180 mm
Frequency	**835 MHz** ± 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	**interpolated maximum**
Maximum measured	100 mW forward power	**0.439 A/m**

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

E-field 10 mm above dipole surface	condition	**interpolated maximum**
Maximum measured above high end	100 mW forward power	166.8 V/m
Maximum measured above low end	100 mW forward power	157.4 V/m
Averaged maximum above arm	100 mW forward power	**162.1 V/m**

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

3 Appendix

3.1 Antenna Parameters

Frequency	**Return Loss**	**Impedance**
800 MHz	18.3 dB	(42.0 - j7.9) Ohm
835 MHz	**26.2 dB**	**(54.9 + j1.6) Ohm**
900 MHz	15.7 dB	(50.2 - j16.7) Ohm
950 MHz	23.6 dB	(48.1 + j6.2) Ohm
960 MHz	18.3 dB	(57.8 + j10.7) Ohm

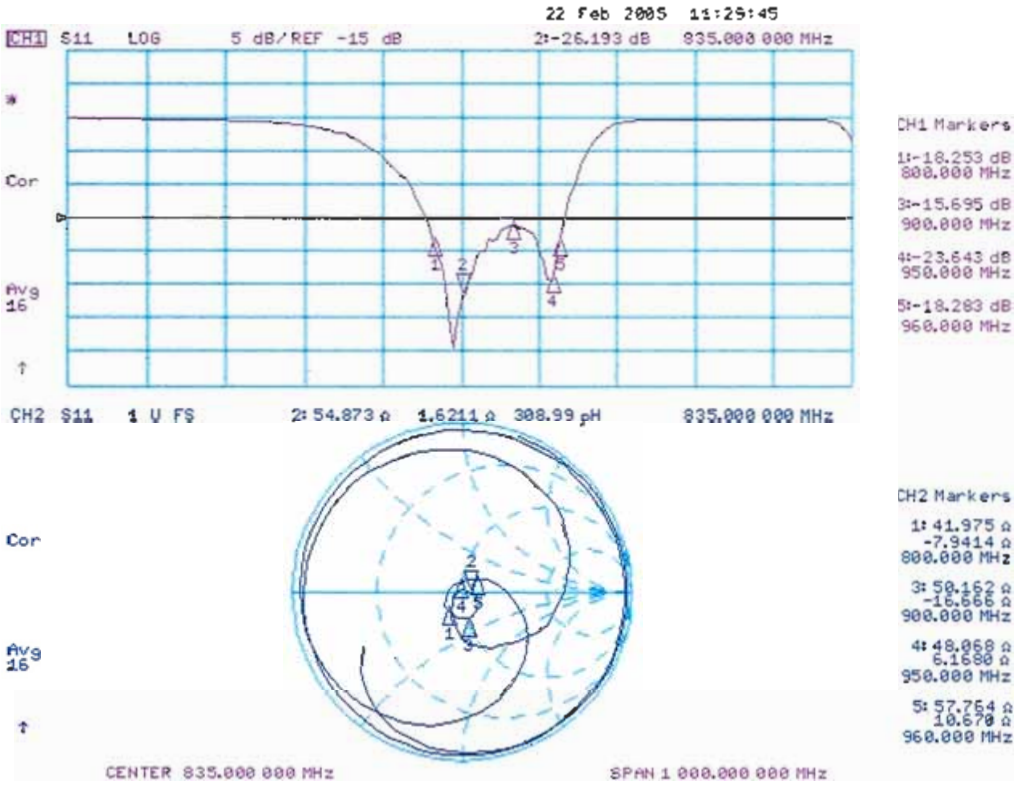
3.2 Antenna Design and Handling

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

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

3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



3.3.2 DASY4 H-field result

See page 5

3.3.3 DASY4 E-Field result

See page 6

Date/Time: 22.02.2005 17:04:11

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: H_CD835_1004_050222.da4

DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1004
Program Name: HAC H Dipole

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

DASY4 Configuration:
- Probe: H3DV6 - SN6065; : Calibrated: 10.12.2004
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn901; Calibrated: 29.06.2004
- Phantom: HAC Phantom; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.5 Build 13; Postprocessing SW: SEMCAD, V1.8 Build 144

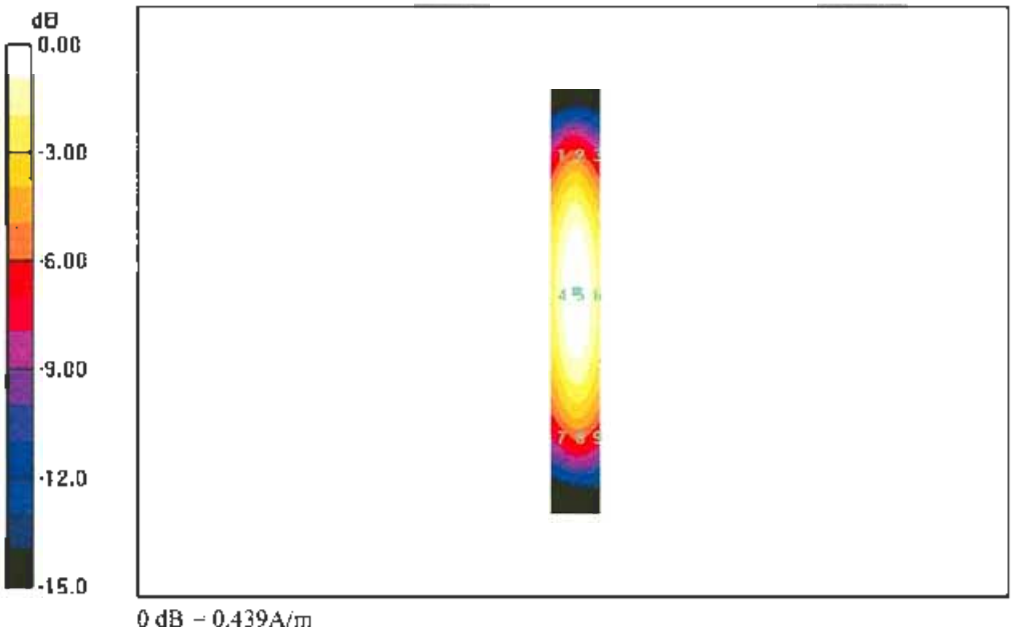
E Scan 10mm above CD 835 MHz/Hearing Aid Compatibility Test (41x361x1): Measurement grid: dx=5mm, dy=5mm, dz=5.5555mm
Maximum value of Total field (slot averaged) = 0.439 A/m
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

H in A/m (Time averaged)

Grid 1	Grid 2	Grid 3
0.369	0.397	0.379
Grid 4	Grid 5	Grid 6
0.406	0.439	0.422
Grid 7	Grid 8	Grid 9
0.344	0.374	0.362

H in A/m (Slot averaged)

Grid 1	Grid 2	Grid 3
0.369	0.397	0.379
Grid 4	Grid 5	Grid 6
0.406	0.439	0.422
Grid 7	Grid 8	Grid 9
0.344	0.374	0.362



0 dB = 0.439A/m

Date/Time: 23.02.2005 15:06:43

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: E_CD835_1004_050223.da4

DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1004
Program Name: HAC E Dipole

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

DASY4 Configuration:
- Probe: ER3DV6 - SN2328; ConvF(1, 1, 1); Calibrated: 06.10.2004
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn901; Calibrated: 29.06.2004
- Phantom: HAC Phantom; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.5 Build 13; Postprocessing SW: SEMCAD, V1.8 Build 144

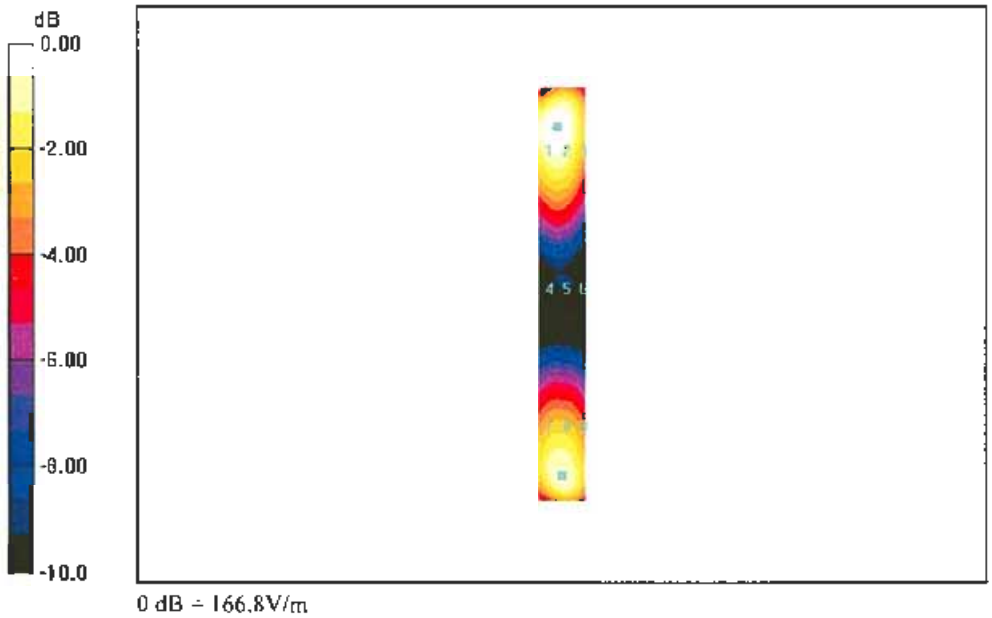
E Scan 10mm above CD 835 MHz/Hearing Aid Compatibility Test (41x361x1): Measurement grid: dx=5mm, dy=5mm, dz=5.5555mm
Maximum value of Total field (slot averaged) = 166.8 V/m
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

E in V/m (Time averaged)

Grid 1	Grid 2	Grid 3
165.6	**166.8**	**155.5**
Grid 4	Grid 5	Grid 6
89.7	**90.9**	**85.8**
Grid 7	Grid 8	Grid 9
151.3	**157.4**	**153.4**

E in V/m (Slot averaged)

Grid 1	Grid 2	Grid 3
165.6	**166.8**	**155.5**
Grid 4	Grid 5	Grid 6
89.7	**90.9**	**85.8**
Grid 7	Grid 8	Grid 9
151.3	**157.4**	**153.4**



0 dB = 166.8V/m

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

Client NOKIA TCC SALO

Certificate No: **CD1880V3-1003_Feb05**

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1003
Calibration procedure(s)	QA CAL-20.v2 Calibration procedure for dipoles in air
Calibration date:	February, 23, 2005
Condition of the calibrated item	In Tolerance

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E442	GB37480704	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Power sensor HP 8481A	US37292783	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Reference 20 dB Attenuator	SN: 5086 (20g)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference Probe ER3DV6	SN 2328	06-Oct-04 (SPEAG, No. ER3-2328_Oct04)	Oct-05
DAE4	SN 601	07-Jan-05 (SPEAG, No. DAE4-601_Jan05)	Jan-06

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092312	10-Aug-03 (SPEAG, in house check Jan-04)	In house check: Oct-05
Power sensor HP 8481A	MY41093315	10-Aug-03 (SPEAG, in house check Jan-04)	In house check: Oct-05
RF generator Agilent E8251A	US41140111	4-Aug-03 (Agilent)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov-05
Probe H3DV6	SN: 6065	10-Oct-04 (SPEAG, No. H3-6065-Oct04)	Calibration, Oct-05

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

Issued: February 27, 2005

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

1 Measurement Conditions

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

DASY Version	DASY4	V4.5 B13
DASY PP Version	SEMCAD	V1.8 B144
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	**0.444 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	134.0 V/m
Maximum measured above low end	100 mW forward power	133.8 V/m
Averaged maximum above arm	100 mW forward power	**133.9 V/m**

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

3 Appendix

3.1 Antenna Parameters

Frequency	**Return Loss**	**Impedance**
1710 MHz	18.6 dB	(57.4 + j11.4) Ohm
1880 MHz	**18.9 dB**	**(61.9 + j4.6) Ohm**
1900 MHz	19.4 dB	(60.8 + j0.3) Ohm
1950 MHz	23.5 dB	(54.1 - j4.2) Ohm
2000 MHz	25.0 dB	(46.3 + j4.1) Ohm

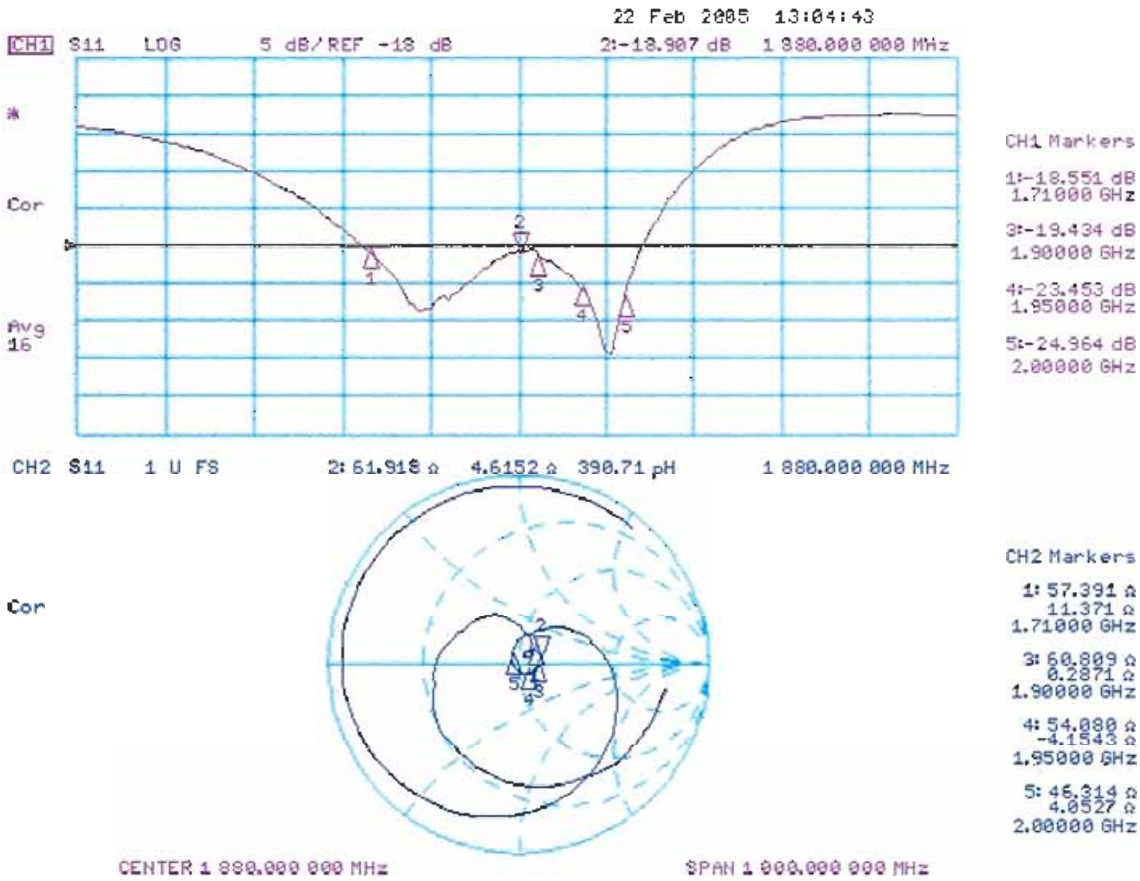
3.2 Antenna Design and Handling

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 DASY4 H-field result

See page 5

3.3.3 DASY4 E-Field result

See page 6

Date/Time: 23.02.2005 11:21:45

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: H_CD1880_1003_050223.da4

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1003
Program Name: HAC H Dipole

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

DASY4 Configuration:
- Probe: H3DV6 - SN6065; : Calibrated: 10.12.2004
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn901; Calibrated: 29.06.2004
- Phantom: HAC Phantom; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.5 Build 13; Postprocessing SW: SEMCAD, V1.8 Build 144

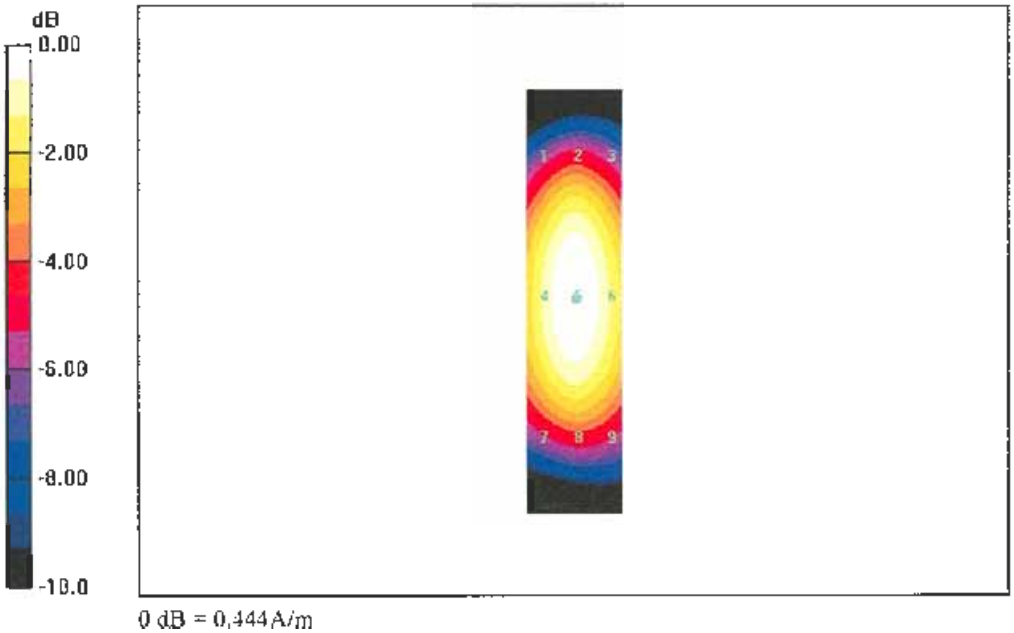
H Scan 10mm above CD 1880 MHz/Hearing Aid Compatibility Test (41x181x1): Measurement grid: dx=5mm, dy=5mm, dz=5.5555mm
Maximum value of Total field (slot averaged) = 0.444 A/m
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

H in A/m (Time averaged)

Grid 1	Grid 2	Grid 3
0.377	**0.406**	**0.389**
Grid 4	Grid 5	Grid 6
0.416	**0.444**	**0.427**
Grid 7	Grid 8	Grid 9
0.375	**0.400**	**0.385**

H in A/m (Slot averaged)

Grid 1	Grid 2	Grid 3
0.377	**0.406**	**0.389**
Grid 4	Grid 5	Grid 6
0.416	**0.444**	**0.427**
Grid 7	Grid 8	Grid 9
0.375	**0.400**	**0.385**



0 dB = 0.444 A/m

Date/Time: 23.02.2005 16:48:43

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: E_CD1880_1003_050223.da4

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1003
Program Name: HAC E Dipole

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 - SN2328; ConvF(1, 1, 1); Calibrated: 06.10.2004
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn901; Calibrated: 29.06.2004
- Phantom: HAC Phantom; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.5 Build 13; Postprocessing SW: SEMCAD, V1.8 Build 144

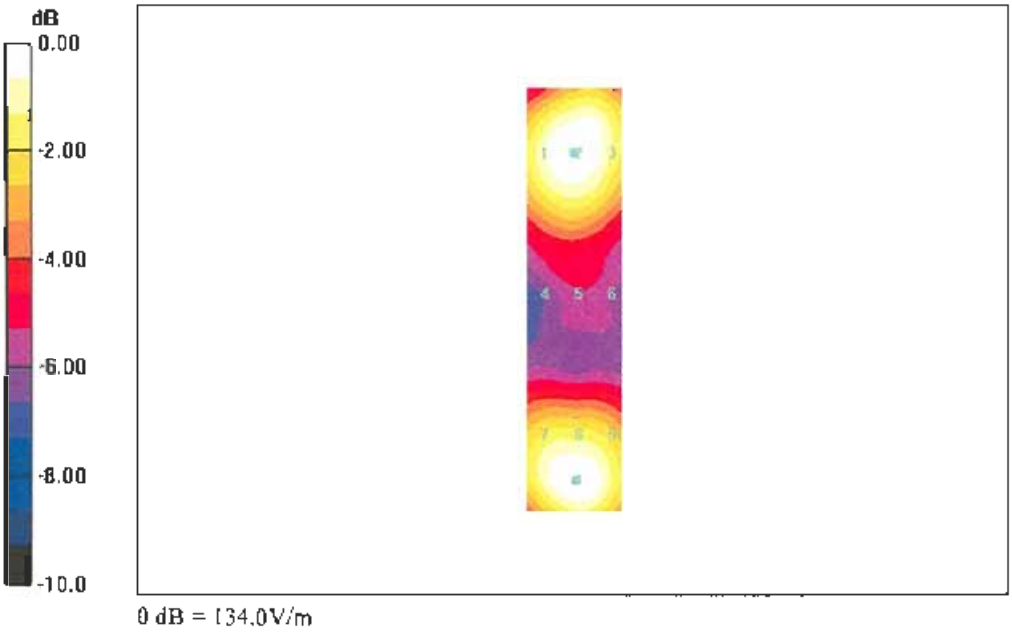
E Scan 10mm above CD 1880 MHz/Hearing Aid Compatibility Test (41x181x1): Measurement grid: dx=5mm, dy=5mm, dz=5.5555mm
Maximum value of Total field (slot averaged) = 134.0 V/m
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

E in V/m (Time averaged)

Grid 1	Grid 2	Grid 3
128.7	**133.8**	**131.0**
Grid 4	Grid 5	Grid 6
89.7	**92.3**	**88.8**
Grid 7	Grid 8	Grid 9
127.5	**134.0**	**131.4**

E in V/m (Slot averaged)

Grid 1	Grid 2	Grid 3
128.7	**133.8**	**131.0**
Grid 4	Grid 5	Grid 6
89.7	**92.3**	**88.8**
Grid 7	Grid 8	Grid 9
127.5	**134.0**	**131.4**



0 dB = 134.0V/m