TCC
Nokia

FINAS
Finnish Accreditation Service
T117 (EN ISO/IEC 17025)

HAC RF Emissions Test Report

Test report no.:	Salo_HAC_0742_06	**Date of report:**	2007-10-22
Template version:	3.0	**Number of pages:**	24
Testing laboratory:	TCC Nokia Salo Laboratory P.O.Box 86 Joensuunkatu 7H / Kiila 1B FIN-24101 SALO, FINLAND Tel. +358 (0) 7180 08000 Fax. +358 (0) 7180 45220	**Client:**	Nokia Corporation Arco Tower Shimomeguro 1-8-1 Meguro-ku TOKYO 153-0064 JAPAN Tel. +81 3 5759 7001
Responsible test engineer:	Ari Orte	**Product contact person:**	Robert Binder
Measurements made by:	Ari Orte		
Tested devices:	RM-156		
FCC ID:	QVVRM-156		
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:

Digitally signed
by Ari Orte
Date: 2007.10.22
15:10:52 +03'00'

CONTENTS

1. SUMMARY OF HAC RF EMISSION TEST REPORT

1.1 Test Details

Period of test	2007-10-11 to 2007-10-12
SN, HW, SW and DUT numbers of tested device	SN: 353248/01/095608/2, HW: 6105, SW: 30.0.013, DUT: 12283
Batteries used in testing	BL-5F, DUT: 12284, 12285
State of sample	Prototype unit
Notes	AWF = -5 for GSM

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
GSM1900	810 / 1909.8	47.3 – 84.1	64.2	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
GSM1900	810 / 1909.8	0.14 – 0.25	0.157	M3(-5dB)

1.2.3 Overall RF emissions category of the tested device

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

1.2.4 Maximum Drift

Maximum drift during measurements	0.11 dB

1.2.5 Measurement Uncertainty

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

2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

Modes of Operation	Band	Modulation Mode	Duty Cycle	Transmitter Frequency Range (MHz)
GSM	1900	GMSK	1/8	1850 – 1910

Outside of USA the transmitter of the device is capable of operating also in 900MHz, 1800MHz and 2100MHz bands, which are not part of this filing.

2.1 Picture of Device


Flip closed


Flip open

3. TEST CONDITIONS

3.1 Temperature and Humidity

Ambient temperature [°C]:	19.3 to 21.9
Ambient humidity [RH %]:	36 to 42

3.2 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.

4. DESCRIPTION OF THE TEST EQUIPMENT

4.1 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 V4	555	12 months	2008-03
E-field Probe ER3DV6	2333	12 months	2008-02
H-field Probe H3DV6	6053	12 months	2008-02
Dipole Validation Kit, CD1880V3	1003	24 months	2009-02

Additional test equipment used in testing and validation:

Test Equipment	Model	Serial Number	Calibration interval	Calibration expiry
Signal Generator	SML03	101265	12 months	2008-07
Amplifier	ZHL-42 (SMA)	N072095-5	12 months	2008-07
Power Meter	NRVS	849305/028	12 months	2008-07
Power Sensor	NRV-Z32	839176/020	12 months	2008-07
Radio Communication Tester	CMU 200	101111	12 months	2008-07

4.1.1 Isotropic E-field probe ER3DV6

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	General near-field measurements up to 6 GHz Field component measurements Fast automatic scanning in phantoms

4.1.2 Isotropic H-field probe H3DV6

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	General magnetic near-field measurements up to 3 GHz Field component measurements, surface current measurements Measurements in air or liquids, low interaction

4.1.3 Device Holder

The Device Holder and Test Arch are 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 holder 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.

4.2 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

f [MHz]	Description	H-field [A/m]	E-field [V/m]
1880	Reference result	0.452	128.8
	± 10% window	0.406 – 0.497	115.9 – 141.7
	2007-10-11	0.473	131.7

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

5. DESCRIPTION OF THE TEST PROCEDURE

5.1 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

5.2 Test Positions

5.2.1 Scan area centered at the acoustic output

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

Photo of the device positioned under Test Arch

5.3 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 sub grids as described in the C63.19 standard.

5.4 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.

5.5 Probe Modulation Factor

All raw measurements in DASY4 system are presented as RMS values. The measurement software then applies Probe Modulation Factor (PMF) to convert readings to “slot averaged” peak values as required by C63.19 standard.

Therefore PMF was assessed as described in C63.19 standard along with Speag's Application Note (AN_Hearing_Aid_Compatibility.pdf, section 28.8, "Definition / Determination of the Probe Modulation Factor").

Observed Modulation Factor:

$PMF_{(E)}$ = E-field$_{(CW)}$ / E-field $_{(Modulated)}$

$PMF_{(H)}$ = H-field$_{(CW)}$ / H-field $_{(Modulated)}$

Observed Crest Factor:

$CF_{(E)} = (PMF_{(E)})^2$

$CF_{(H)} = (PMF_{(H)})^2$

Modulation factors, GSM

f [MHz]	*p* [dBm]	E-field [V/m] Probe SN: 2333		H-field [A/m] Probe SN: 6053		PMF E-field	PMF H-field
		CW	GSM	CW	GSM		
1880.0	20	136.3	48.4	0.506	0.249	2.82	2.03

5.6 Slot Averaged Calculation Method

The slot-averaged values for the every measured signal type were calculated using observed duty cycles.

5.7 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).

5.8 Category Limits

From remaining maximum values after exclusion process, Hearing Aid M-category is defined according to the category limits of C63.19 - 2006.

		Limits for RF-parameters <960MHz				Limits for RF-parameters >960MHz			
Category	AWF [dB]	E-field [V/m]		H-field [A/m]		E-field [V/m]		H-field [A/m]	
		Min	Max	Min	Max	Min	Max	Min	Max
M1	0	631.0	1122.0	1.91	3.39	199.5	354.8	0.6	1.07
M1	-5	473	841.4	1.43	2.54	149.6	266.1	0.45	0.8
M2	0	354.8	631.0	1.07	1.91	112.2	199.5	0.34	0.6
M2	-5	266.1	473.2	0.80	1.43	84.1	149.6	0.25	0.45
M3	0	**199.5**	**354.8**	**0.60**	**1.07**	**63.1**	**112.2**	**0.19**	**0.34**
M3	-5	**149.6**	**266.1**	**0.45**	**0.80**	**47.3**	**84.1**	**0.14**	**0.25**
M4	0		<199.5		<0.60		<63.1		<0.19
M4	-5		<149.6		<0.45		<47.3		<0.14

6. 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								
Device 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 Test Arch	2.4	R	√3	1	1	1.4	1.4	
Power Drift	5.0	R	√3	1	1	2.9	2.9	SAR
TEST ARCH AND SETUP RELATED								
Test Arch 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**	

7. RESULTS

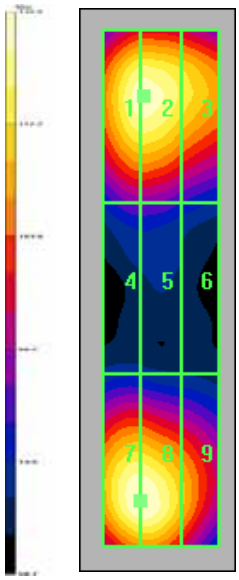
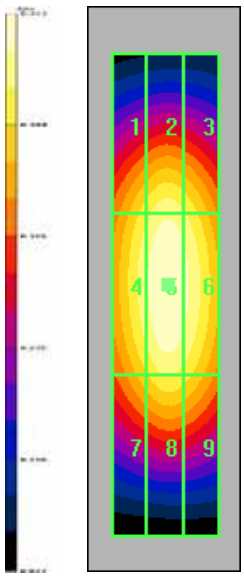
The calculated maximum field values for the test device are tabulated below:

GSM1900, E and H RF emissions results

Mode	Flip option	Test configuration	Ch 512 1850.2MHz	Ch 661 1880.0MHz	Ch 810 1909.8MHz
GSM1900	Flip open	E-field [V/M]	57.2	58.3	**64.2**
		H-field [A/m]	0.124	0.134	**0.157**
		Category	M3(-5dB)	M3(-5dB)	M3(-5dB)

Plots of the measurement scans are shown in **Appendix B.** Excluded cells are colored orange.

APPENDIX A: SYSTEM VALIDATION SCAN

Date/Time: 2007-10-11 15:04:42 Test Laboratory: TCC Nokia **Type: CD1880V3; Serial: 1003**	Date/Time: 2007-10-11 12:27:30 Test Laboratory: TCC Nokia **Type: CD1880V3; Serial: 1003**
Communication System: CW Frequency: 1880 MHz; Duty Cycle: 1:1 Medium: Air; Medium Notes: Not Specified Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m^3 Phantom section: E Dipole Section	Communication System: CW Frequency: 1880 MHz; Duty Cycle: 1:1 Medium: Air; Medium Notes: Not Specified Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3 Phantom section: H Dipole Section
DASY4 Configuration: - Probe: ER3DV6 - SN2333; Probe Notes: - ConvF(1, 1, 1); Calibrated: 2007-02-13 - Sensor-Surface: (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - 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	DASY4 Configuration: - Probe: H3DV6 - SN6053; Probe Notes: - ; Calibrated: 2007-02-13 - Sensor-Surface: (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - 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 - ER probe center 10mm above CD1880 Dipole/Hearing Aid Compatibility Test (41x181x1): Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 132.5 V/m Probe Modulation Factor = 1.00 Reference Value = 140.6 V/m; Power Drift = -0.019 dB **Hearing Aid Near-Field Category: M2 (AWF 0 dB)**	**H Scan - H3DV6 probe center 10mm above CD1880 Dipole/Hearing Aid Compatibility Test (41x181x1):** Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 0.473 A/m Probe Modulation Factor = 1.00 Reference Value = 0.501 A/m; Power Drift = 0.013 dB **Hearing Aid Near-Field Category: M2 (AWF 0 dB)**
	

Grid 1 **130.8**	Grid 2 **130.9**	Grid 3 **121.6**
Grid 4 **85.4**	Grid 5 **85.4**	Grid 6 **78.8**
Grid 7 **132.5**	Grid 8 **132.5**	Grid 9 **115.1**

Grid 1 **0.412**	Grid 2 **0.440**	Grid 3 **0.423**
Grid 4 **0.443**	Grid 5 **0.473**	Grid 6 **0.456**
Grid 7 **0.391**	Grid 8 **0.421**	Grid 9 **0.406**

APPENDIX B: MEASUREMENT SCANS

MEASUREMENT DATA GSM1900, CHANNEL LOW (1850.2 MHz)

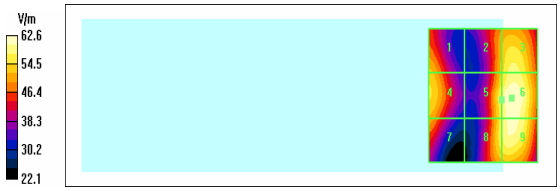
Date/Time: 2007-10-12 18:49:05 Test Laboratory: TCC Nokia **Type: RM-156; Serial: 353248/01/095608/2**	Date/Time: 2007-10-12 14:33:17 Test Laboratory: TCC Nokia **Type: RM-156; Serial: 353248/01/095608/2**
Communication System: GSM1900 (ER3DV6) Frequency: 1850.2 MHz; Duty Cycle: 1:7.8 Medium: Air; Medium Notes: Not Specified Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m^3 Phantom section: E Device Section	Communication System: GSM1900 (H3DV6) Frequency: 1850.2 MHz; Duty Cycle: 1:4.16 Medium: Air; Medium Notes: Not Specified Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3 Phantom section: H Device Section
DASY4 Configuration: - Probe: ER3DV6 - SN2333; Probe Notes: - ConvF(1, 1, 1); Calibrated: 2007-02-13 - Sensor-Surface: (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: Not Specified - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172	DASY4 Configuration: - Probe: H3DV6 - SN6053; Probe Notes: - ; Calibrated: 2007-02-13 - Sensor-Surface: (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: Not Specified - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
E Scan - ER3DV6 - measurement distance from the closest probe sensor part to the Device = 10mm (low)/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 60.0 V/m Probe Modulation Factor = 2.82 Reference Value = 13.8 V/m; Power Drift = -0.038 dB **Hearing Aid Near-Field Category: M3 (AWF -5 dB)**	**H Scan - H3DV6 - measurement distance from the closest probe sensor part to the Device = 10mm (Low)/Hearing Aid Compatibility Test (101x101x1):** Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 0.129 A/m Probe Modulation Factor = 2.03 Reference Value = 0.047 A/m; Power Drift = -0.012 dB **Hearing Aid Near-Field Category: M4 (AWF -5 dB)**

Grid 1 52.1	Grid 2 46.4	Grid 3 51.9
Grid 4 53.3	Grid 5 55.3	Grid 6 59.5
Grid 7 48.1	Grid 8 57.2	Grid 9 60.0

Grid 1 0.129	Grid 2 0.128	Grid 3 0.103
Grid 4 0.105	Grid 5 0.105	Grid 6 0.091
Grid 7 0.124	Grid 8 0.115	Grid 9 0.077

MEASUREMENT DATA GSM1900, CHANNEL MIDDLE (1880 MHz)

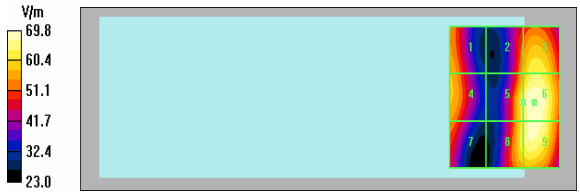
Date/Time: 2007-10-12 18:25:08 Test Laboratory: TCC Nokia **Type: RM-156; Serial: 353248/01/095608/2**	Date/Time: 2007-10-12 14:01:26 Test Laboratory: TCC Nokia **Type: RM-156; Serial: 353248/01/095608/2**
Communication System: GSM1900 (ER3DV6) Frequency: 1880 MHz; Duty Cycle: 1:7.8 Medium: Air; Medium Notes: Not Specified Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m^3 Phantom section: E Device Section	Communication System: GSM1900 (H3DV6) Frequency: 1880 MHz; Duty Cycle: 1:4.16 Medium: Air; Medium Notes: Not Specified Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3 Phantom section: H Device Section
DASY4 Configuration: - Probe: ER3DV6 - SN2333; Probe Notes: - ConvF(1, 1, 1); Calibrated: 2007-02-13 - Sensor-Surface: (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: Not Specified - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172	DASY4 Configuration: - Probe: H3DV6 - SN6053; Probe Notes: - ; Calibrated: 2007-02-13 - Sensor-Surface: (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: Not Specified - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
E Scan - ER3DV6 - measurement distance from the closest probe sensor part to the Device = 10mm (Middle)/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 62.6 V/m Probe Modulation Factor = 2.82 Reference Value = 15.2 V/m; Power Drift = -0.033 dB **Hearing Aid Near-Field Category: M3 (AWF -5 dB)**	**H Scan - H3DV6 - measurement distance from the closest probe sensor part to the Device = 10mm (middle)/Hearing Aid Compatibility Test (101x101x1):** Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 0.146 A/m Probe Modulation Factor = 2.03 Reference Value = 0.054 A/m; Power Drift = -0.108 dB **Hearing Aid Near-Field Category: M3 (AWF -5 dB)**



Grid 1 **52.9**	Grid 2 **53.5**	Grid 3 **58.5**
Grid 4 **55.0**	Grid 5 **58.3**	Grid 6 **62.6**
Grid 7 **51.2**	Grid 8 **57.0**	Grid 9 **61.2**

Grid 1 **0.146**	Grid 2 **0.141**	Grid 3 **0.107**
Grid 4 **0.122**	Grid 5 **0.120**	Grid 6 **0.097**
Grid 7 **0.134**	Grid 8 **0.128**	Grid 9 **0.087**

MEASUREMENT DATA GSM1900, CHANNEL HIGH (1909.8 MHz)

Date/Time: 2007-10-12 18:31:30 Test Laboratory: TCC Nokia **Type: RM-156; Serial: 353248/01/095608/2**	Date/Time: 2007-10-12 14:15:39 Test Laboratory: TCC Nokia **Type: RM-156; Serial: 353248/01/095608/2**
Communication System: GSM1900 (ER3DV6) Frequency: 1909.8 MHz; Duty Cycle: 1:7.8 Medium: Air; Medium Notes: Not Specified Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1000 kg/m^3 Phantom section: E Device Section	Communication System: GSM1900 (H3DV6) Frequency: 1909.8 MHz; Duty Cycle: 1:4.16 Medium: Air; Medium Notes: Not Specified Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3 Phantom section: H Device Section
DASY4 Configuration: - Probe: ER3DV6 - SN2333; Probe Notes: - ConvF(1, 1, 1); Calibrated: 2007-02-13 - Sensor-Surface: (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: Not Specified - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172	DASY4 Configuration: - Probe: H3DV6 - SN6053; Probe Notes: - ; Calibrated: 2007-02-13 - Sensor-Surface: (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: Not Specified - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
E Scan - ER3DV6 - measurement distance from the closest probe sensor part to the Device = 10mm (High)/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 69.8 V/m Probe Modulation Factor = 2.82 Reference Value = 15.7 V/m; Power Drift = -0.071 dB **Hearing Aid Near-Field Category: M3 (AWF -5 dB)**	**H Scan - H3DV6 - measurement distance from the closest probe sensor part to the Device = 10mm (High)/Hearing Aid Compatibility Test (101x101x1):** Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 0.169 A/m Probe Modulation Factor = 2.03 Reference Value = 0.062 A/m; Power Drift = -0.026 dB **Hearing Aid Near-Field Category: M3 (AWF -5 dB)**
	

Grid 1 **57.1**	Grid 2 **57.0**	Grid 3 **63.8**
Grid 4 **58.3**	Grid 5 **64.2**	Grid 6 **69.8**
Grid 7 **54.2**	Grid 8 **63.7**	Grid 9 **68.7**

Grid 1 **0.157**	Grid 2 **0.156**	Grid 3 **0.123**
Grid 4 **0.143**	Grid 5 **0.140**	Grid 6 **0.112**
Grid 7 **0.169**	Grid 8 **0.161**	Grid 9 **0.108**

APPENDIX C: RELEVANT PAGES FROM PROBE CALIBRATION REPORT(S)

E-field probe ER3DV6, SN: 2333
H-field probe H3DV6, SN: 6053

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

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Accreditation No.: SCS 108

Client **Nokia Salo TCC**

Certificate No: ER3-2333_Feb07

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:	February 13, 2007
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41495277	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41498087	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-06 (METAS, No. 217-00592)	Aug-07
Reference 20 dB Attenuator	SN: S5086 (20b)	4-Apr-06 (METAS, No. 251-00558)	Apr-07
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-06 (METAS, No. 217-00593)	Aug-07
Reference Probe ER3DV6	SN: 2328	2-Oct-06 (SPEAG, No. ER3-2328_Oct06)	Oct-07
DAE4	SN: 654	21-Jun-06 (SPEAG, No. DAE4-654_Jun06)	Jun-07

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

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

Issued: February 13, 2007

DASY - Parameters of Probe: ER3DV6 SN:2333

Sensitivity in Free Space [μV/(V/m)^2]		Diode Compression[A]	
NormX	**1.44** ± 10.1 % (k=2)	DCP X	**94** mV
NormY	**1.50** ± 10.1 % (k=2)	DCP Y	**94** mV
NormZ	**1.46** ± 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

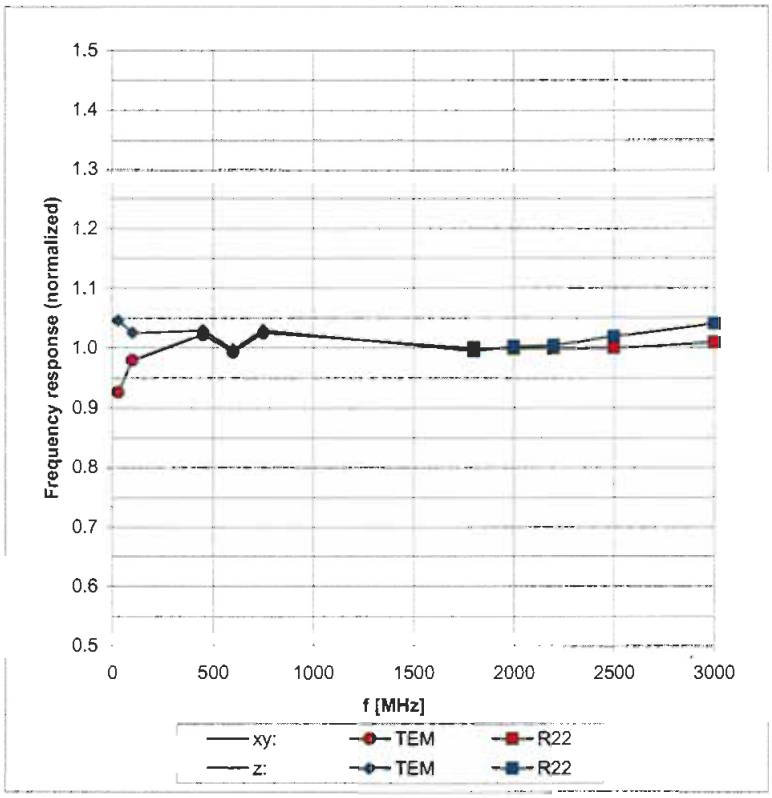
Connector Angle **-74** °

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

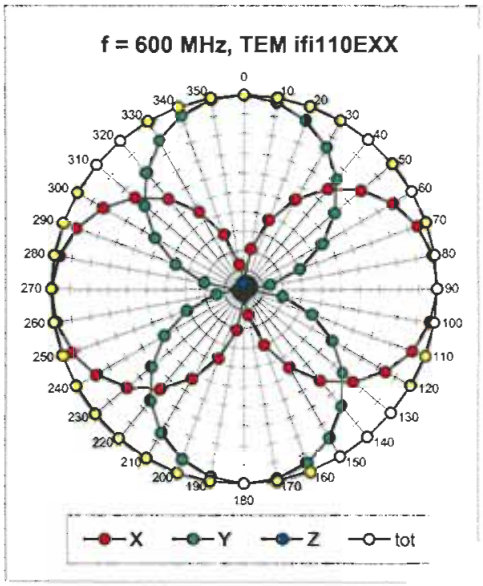
Frequency Response of E-Field

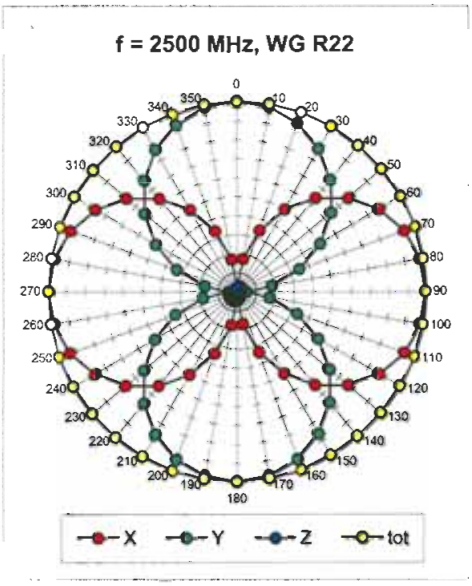
(TEM-Cell:ifi110 EXX, Waveguide R22)



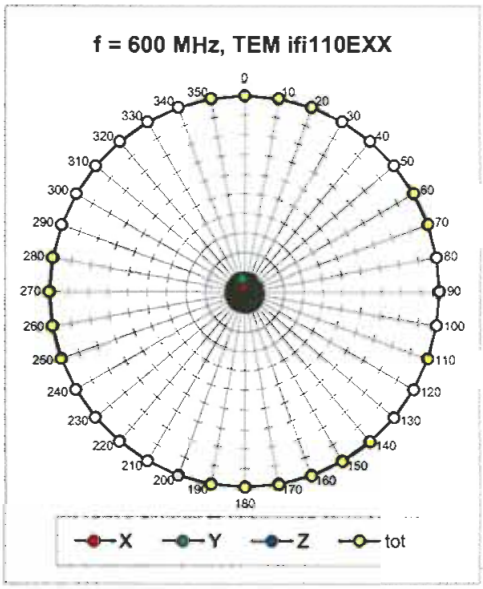
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

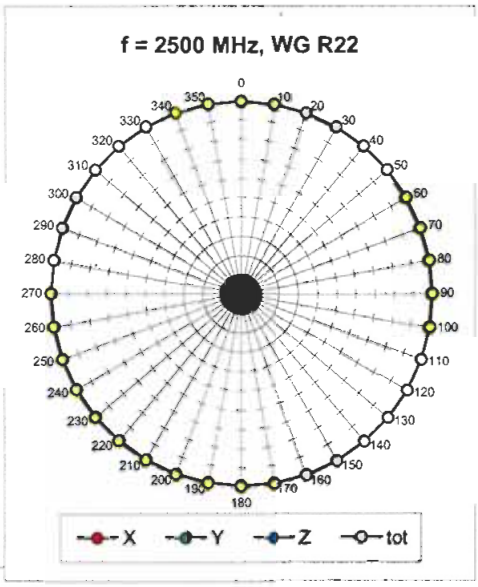
Receiving Pattern (ϕ), ϑ = 0°



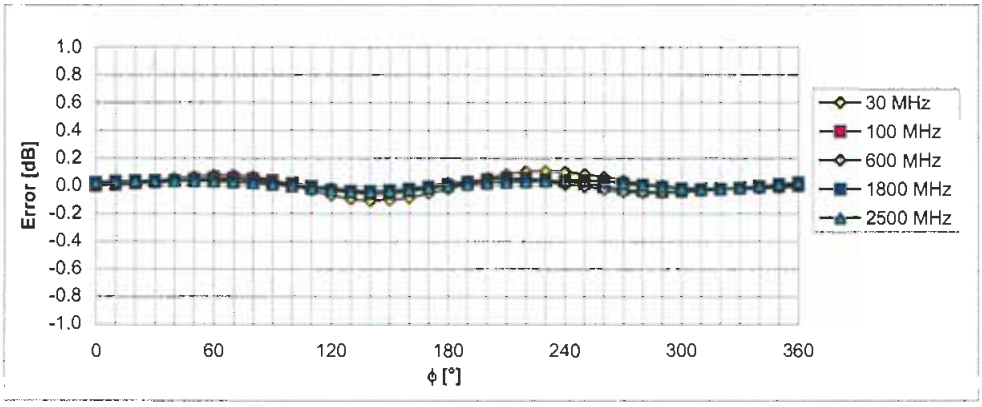


Receiving Pattern (ϕ), ϑ = 90°



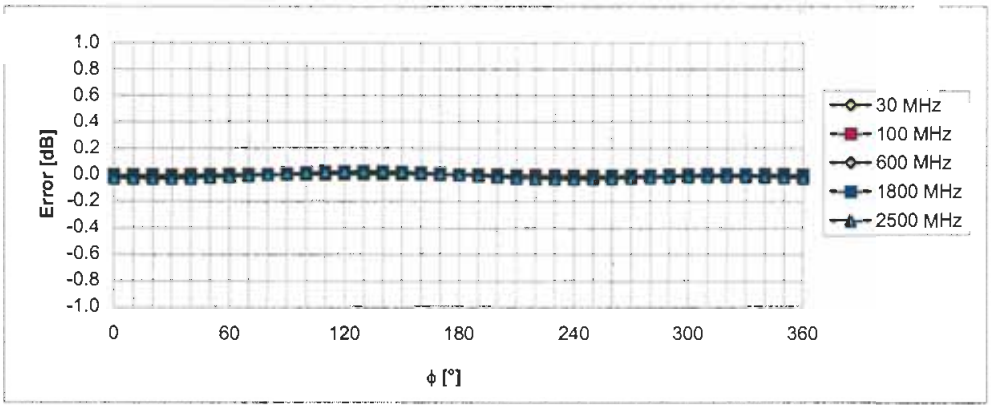


Receiving Pattern (ϕ), ϑ = 0°



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

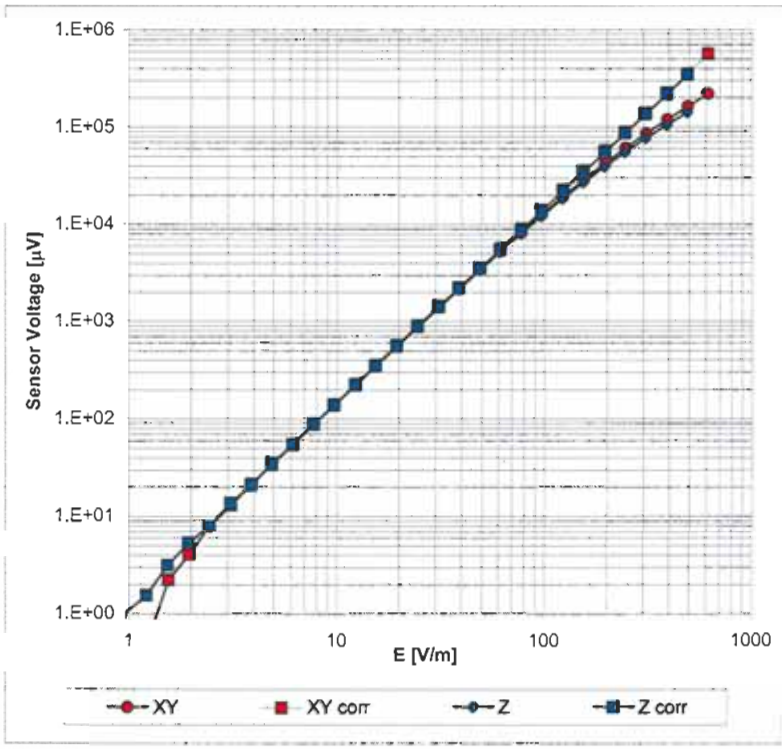
Receiving Pattern (ϕ), ϑ = 90°

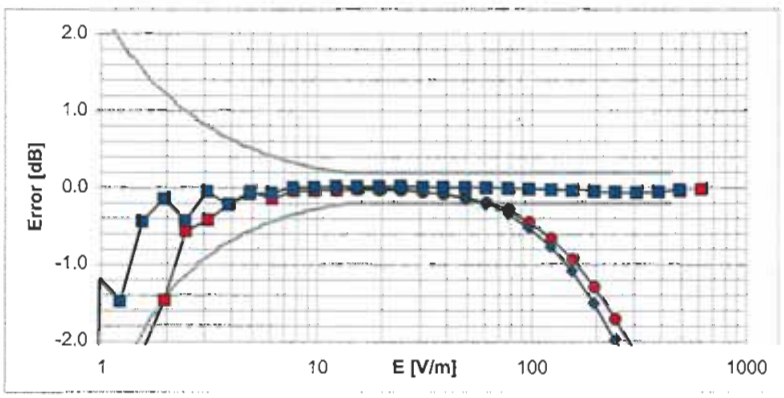


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(E-field)

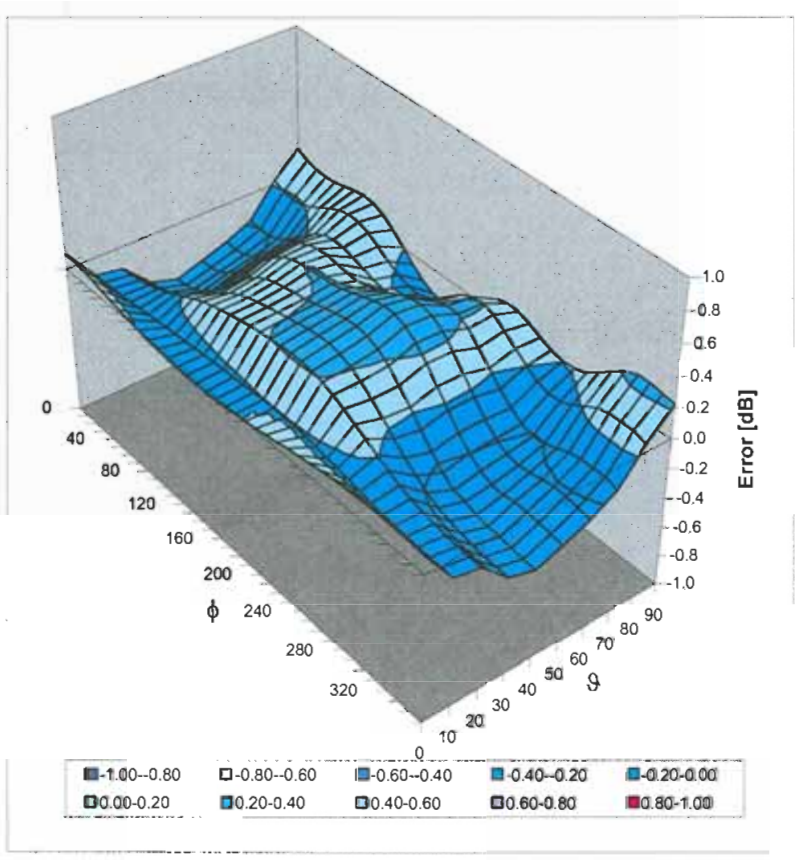
(Waveguide R22, f = 1800 MHz)





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)

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Accreditation No.: SCS 108

Client Nokia Salo TCC

Certificate No: H3-6053_Feb07

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:	February 13, 2007
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41495277	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41498087	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-06 (METAS, No. 217-00592)	Aug-07
Reference 20 dB Attenuator	SN: S5086 (20b)	4-Apr-06 (METAS, No. 251-00558)	Apr-07
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-06 (METAS, No. 217-00593)	Aug-07
Reference Probe H3DV6	SN: 6182	2-Oct-06 (SPEAG, No. H3-6182_Oct06)	Oct-07
DAE4	SN: 654	21-Jun-06 (SPEAG, No. DAE4-654_Jun06)	Jun-07

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

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

Issued: February 13, 2007

DASY - Parameters of Probe: H3DV6 SN:6053

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

	a0	a1	a2	
X	**2.724E-03**	**-8.535E-5**	**-3.619E-5**	± 5.1 % (k=2)
Y	**2.567E-03**	**-2.007E-4**	**7.239E-5**	± 5.1 % (k=2)
Z	**2.914E-03**	**-3.715E-4**	**5.754E-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

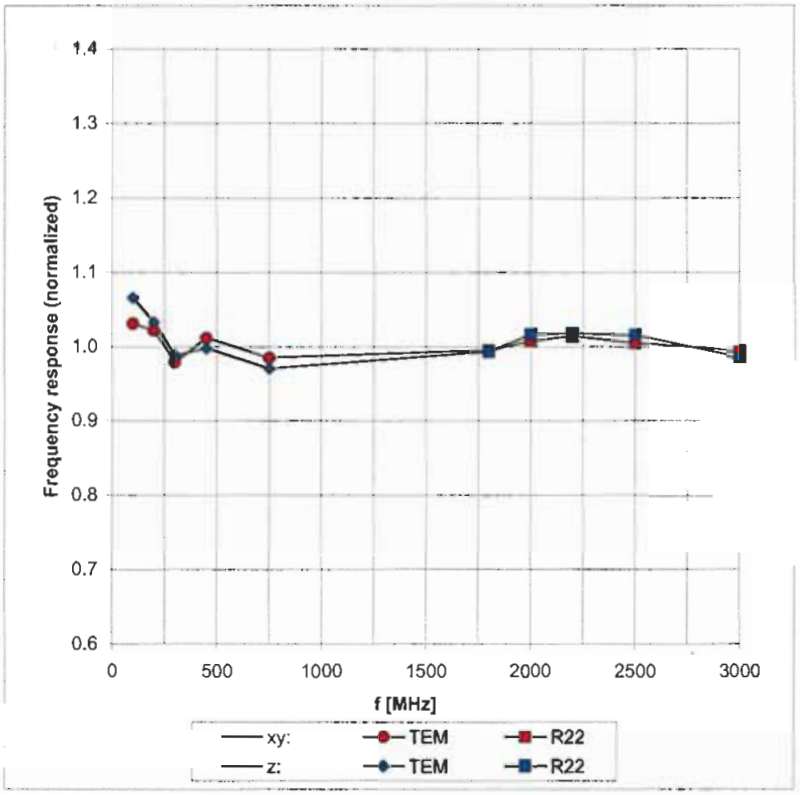
Connector Angle **37** °

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

[1] numerical linearization parameter: uncertainty not required

Frequency Response of H-Field

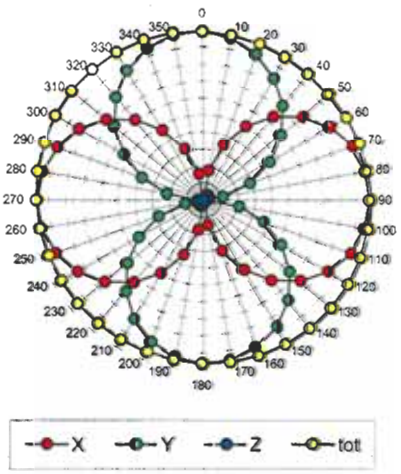
(TEM-Cell:ifi110, Waveguide R22)



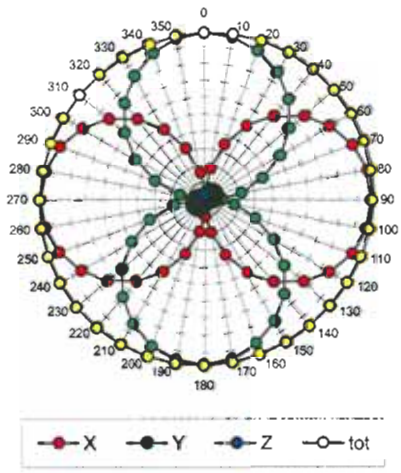
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 90°

f = 300 MHz, TEM ifi110EXX

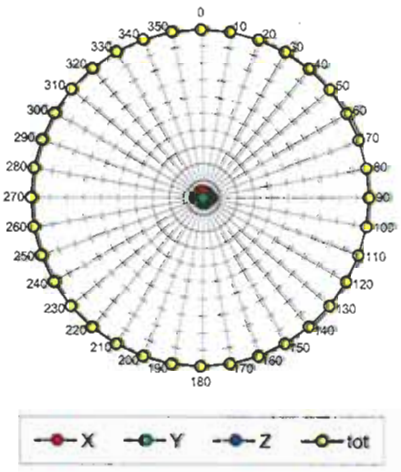


f = 2500 MHz, WG R22

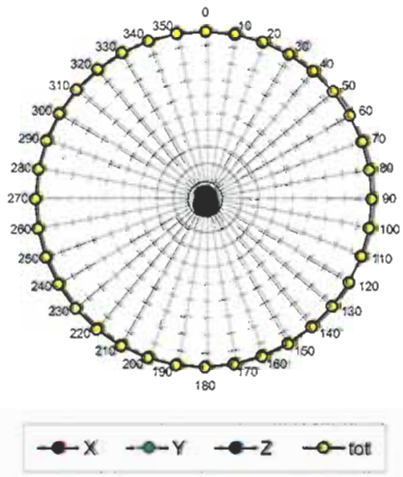


Receiving Pattern (ϕ), ϑ = 0°

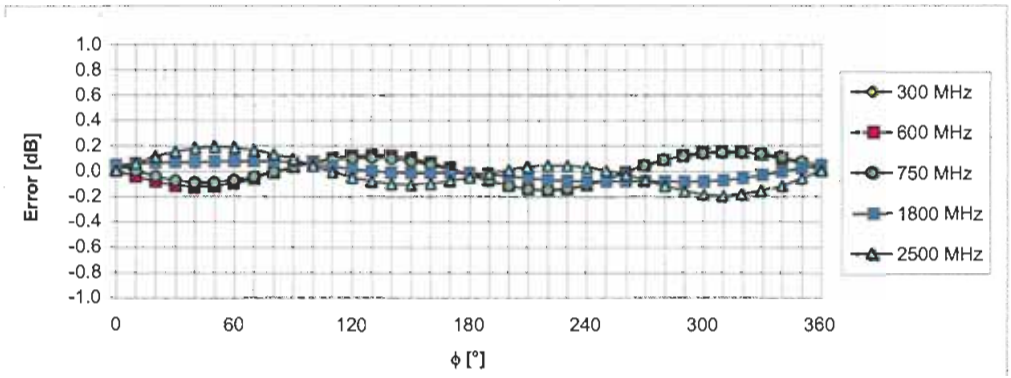
f = 300 MHz, TEM ifi110EXX



f = 2500 MHz, WG R22

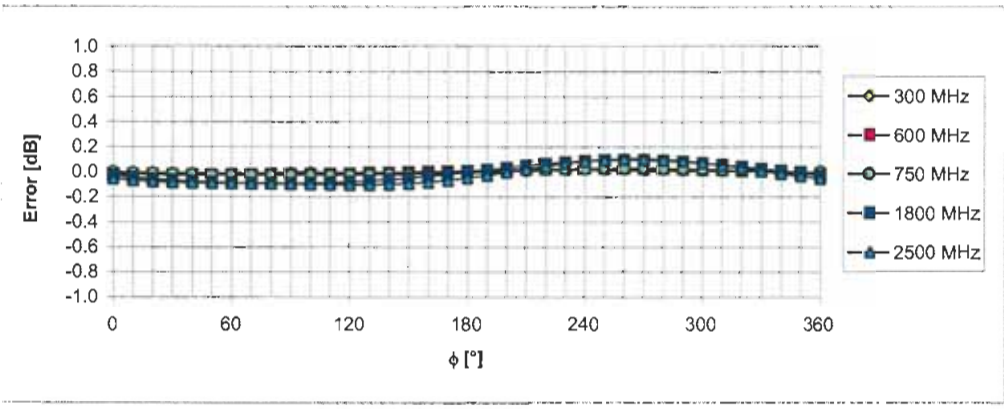


Receiving Pattern (ϕ), ϑ = 90°



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

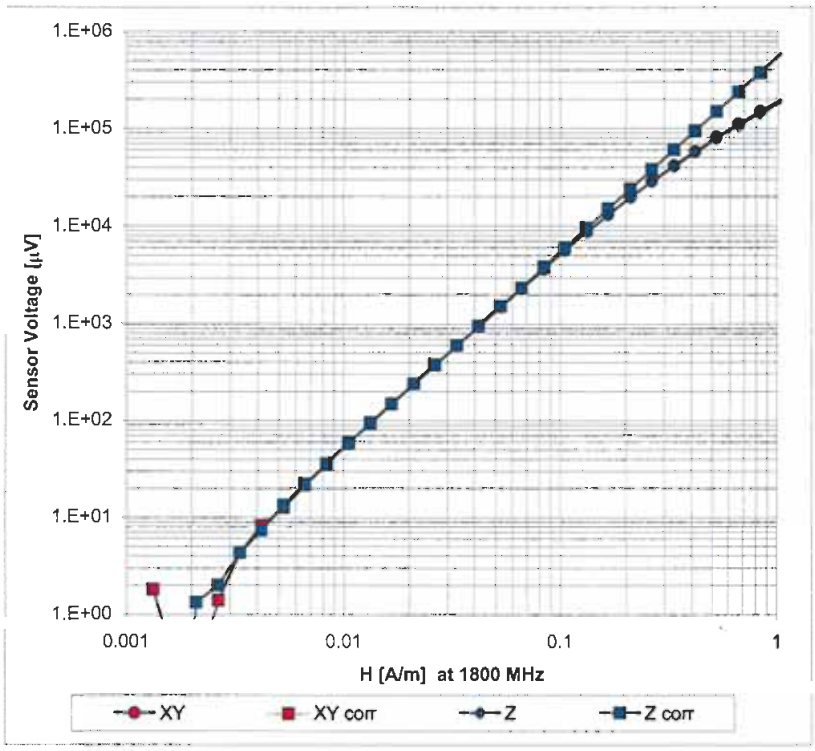
Receiving Pattern (ϕ), ϑ = 0°

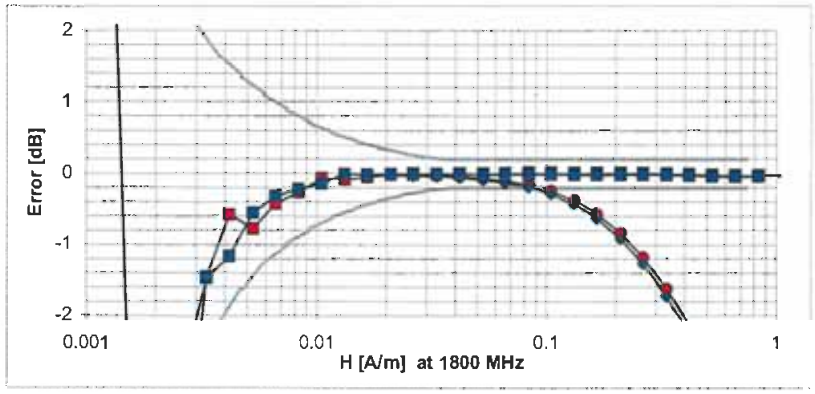


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(H-field)

(Waveguide R22, f = 1800 MHz)





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

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

1880MHz dipole CD1880V3, SN: 1003

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

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S Swiss Calibration Service

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Accreditation No.: SCS 108

Client **Nokia Salo TCC**

Certificate No: CD1880V3-1003_Feb07

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1003
Calibration procedure(s)	QA CAL-20.v4 Calibration procedure for dipoles in air
Calibration date:	February 12, 2007
Condition of the calibrated item	In Tolerance

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
DAE4	SN: 660	1-Mar-06 (SPEAG, No. DAE4-660_Mar06)	Calibration, Mar-07
Probe ER3DV6	SN: 2336	27-Dec-06 (SPEAG, No. ER3-2336_Dec06)	Calibration, Dec-07
Probe H3DV6	SN: 6065	27-Dec-06 (SPEAG, No. H3-6065-Dec06)	Calibration, Dec-07
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Power meter EPM-4419B	GB43310788	12-Aug-03 (SPEAG, in house check Oct-06)	In house check: Oct-07
Power sensor HP 8481A	MY41093312	10-Aug-03 (SPEAG, in house check Oct-06)	In house check: Oct-08
Power sensor HP 8481A	MY41093315	10-Aug-03 (SPEAG, in house check Oct-06)	In house check: Oct-08
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07
RF generator R&S SMT06	SN: 100005	26-Jul-04 (SPEAG, in house check Nov-05)	In house check: Nov-07

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

Issued: February 14, 2007

1 Measurement Conditions

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

DASY Version	DASY4	V4.7 B53
DASY PP Version	SEMCAD	V1.8 B172
Phantom	HAC Test Arch	SD HAC P01 BA, #1002
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 90 mm
Frequency	**1880 MHz** ± 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured	100 mW forward power	**0.452 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	130.9 V/m
Maximum measured above low end	100 mW forward power	126.7 V/m
Averaged maximum above arm	100 mW forward power	**128.8 V/m**

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

3 Appendix

3.1 Antenna Parameters

Frequency	**Return Loss**	**Impedance**
1710 MHz	19.0 dB	(49.8 + j11.3) Ohm
1880 MHz	**19.9 dB**	**(53.7 + j9.9) Ohm**
1900 MHz	19.8 dB	(56.3 + j9.0) Ohm
1950 MHz	23.7 dB	(57.0 – j0.7) Ohm
2000 MHz	26.2 dB	(45.4 + j0.7) 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.

3.3.2 DASY4 H-Field Result

Date/Time: 2/12/2007 4:55:48 PM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1003

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

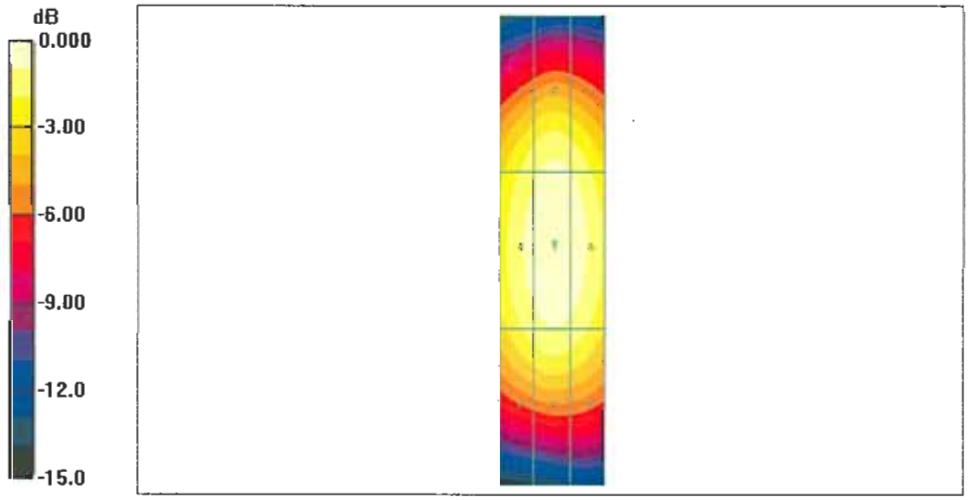
DASY4 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 12/27/2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 3/1/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

H Scan - Sensor Center 10mm above CD1880V3 Dipole/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.452 A/m
Probe Modulation Factor = 1.00
Reference Value = 0.476 A/m; Power Drift = 0.007 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.392**	Grid 2 **0.419**	Grid 3 **0.404**
Grid 4 **0.425**	Grid 5 **0.452**	Grid 6 **0.437**
Grid 7 **0.378**	Grid 8 **0.401**	Grid 9 **0.388**



0 dB = 0.452A/m

3.3.3 DASY4 E-Field Result

Date/Time: 2/12/2007 2:59:33 PM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1003

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

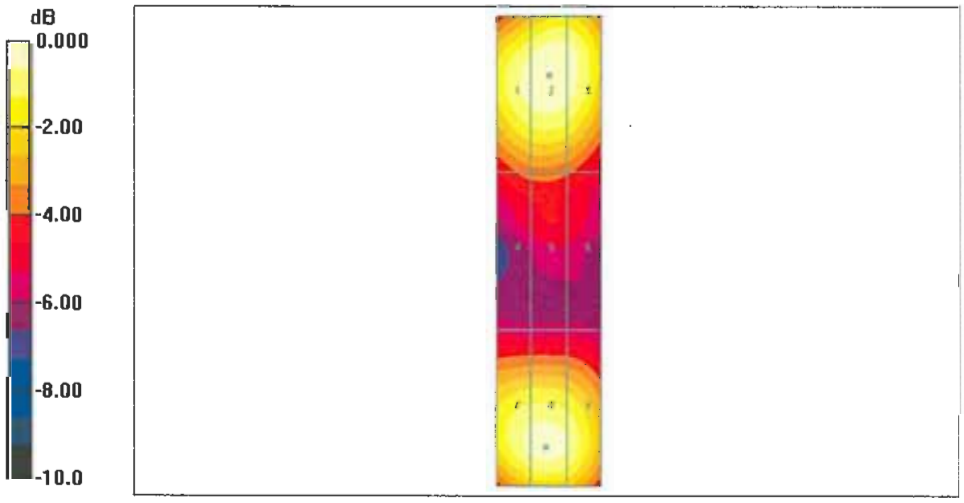
DASY4 Configuration:

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

E Scan - Sensor Center 10mm above CD1880V3 Dipole/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 130.9 V/m
Probe Modulation Factor = 1.00
Reference Value = 139.0 V/m; Power Drift = 0.015 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **126.8**	Grid 2 **130.9**	Grid 3 **127.9**
Grid 4 **86.2**	Grid 5 **87.1**	Grid 6 **84.0**
Grid 7 **123.9**	Grid 8 **126.7**	Grid 9 **121.4**



0 dB = 130.9V/m