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HAC T-Coil Signal Test Report

Test report no.:	Salo_HAC_0719_11	**Date of report:**	2007-05-21
Template version:	2.0	**Number of pages:**	33
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Responsible test engineer:	Ari Orte	**Product contact person:**	Bill Griffin
Measurements made by:	Ari Orte		
Tested devices:	RM-289 (Hearing aid mode active), HW: 4002		
FCC ID:	QMNRM-289	**IC:**	661X-RM289
Supplement reports:	Salo_HAC_0719_10 Salo_HAC_0721_04_setup_photos.pdf		
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
DN: CN = Ari Orte, C = FI, O = Nokia, OU = CertMT
Date: 2007.05.22 09:53:27 +03'00'

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CONTENTS

1. SUMMARY OF HAC T-COIL SIGNAL TEST REPORT

1.1 Test Details

Period of test	2007-04-30 to 2007-05-02
SN, HW, SW and EUT numbers of tested device	SN: 004400/99/176008/1, HW: 4002, SW: gr06w47_07w13 DUT: 11872
Batteries used in testing	BL-5C, DUT: 11546, 11731
State of sample	Prototype unit
Notes	AWF = -5 for GSM, 0 for WCDMA

1.2 Summary of T-Coil Test Results

1.2.1 T-Coil Coupling Field Intensity

1.2.1.1 Axial Field Intensity

Mode	Minimum limit [dB (A/m)]	Result [dB (A/m)]	Verdict
GSM 850	-13	2.4	Pass
WCDMA 850	-13	-0.8	Pass
GSM 1900	-13	2.5	Pass
WCDMA 1900	-13	1.8	Pass

1.2.1.2 Radial Field Intensity

Mode	Minimum limit [dB (A/m)]	Minimum Result [dB (A/m)]	Verdict
GSM 850	-18	8.2	Pass
WCDMA 850	-18	4.9	Pass
GSM 1900	-18	9.3	Pass
WCDMA 1900	-18	6.8	Pass

1.2.2 Frequency Response at Axial Measurement Point

Mode	Verdict
GSM 850	Pass
WCDMA 850	Pass
GSM 1900	Pass
WCDMA 1900	Pass

1.2.3 Signal Quality

Mode	Minimum limit [dB]				Minimum result [dB]	Category
	T1	T2	T3	T4		
GSM 850	-15	-5	5	15	41.4	T4
WCDMA 850	-15	-5	5	15	34.8	T4
GSM 1900	-15	-5	5	15	38.5	T4
WCDMA 1900	-15	-5	5	15	34.8	T4

Mode	RF emissions category at T-coil axial measurement point (E- and H-fields)*	HAC category of the tested device (RF emissions and T-coil requirements combined)
GSM 850	M3	M3/T3
WCDMA 850	M4	M4/T4
GSM 1900	M3	M3/T3
WCDMA 1900	M4	M4/T4

*See separate report 'Salo_HAC_0719_10.pdf'

1.3 Description of the Equipment Under Test (EUT)

Modes and Bands of Operation	GSM 850 / 1900	WCDMA 850 / 1900
Modulation Mode	GMSK	QPSK
Duty Cycle	1/8	1
Transmitter Frequency Range (MHz)	824 - 849 1850 - 1910	826 - 847 1852 - 1908

Outside of USA, tested device is also capable of operating in GSM900 and GSM1800 band, which are not part of this filing.

2. TEST CONDITIONS

2.1 Temperature and Humidity

Ambient temperature (°C):	21.0 to 23.0
Ambient humidity (RH %):	36 to 45

2.2 WD Control

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. Speech coding was processed with EFR speech codec for GSM and with AMR 12.2 kbps for WCDMA.

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

In all operating bands the measurements were performed on middle channel.

2.3 WD Parameters

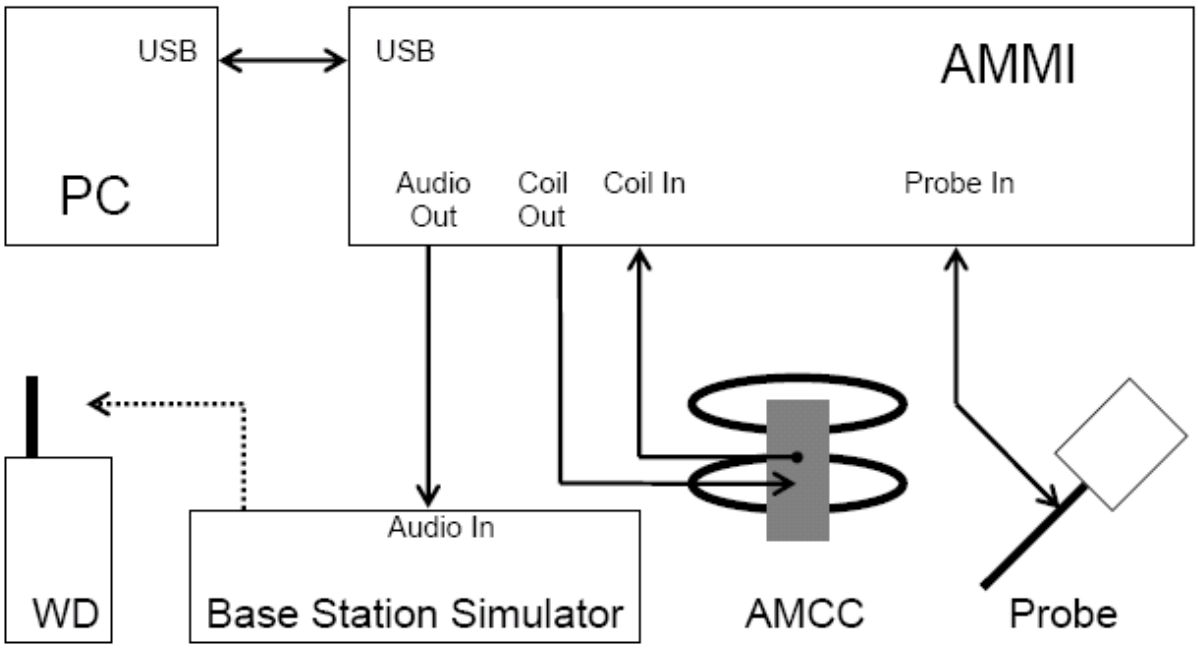
HAC mode was switched on from the WD user interface, volume setting was set to maximum and microphone was muted.

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 software version 4.7, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland.

Components and signal paths of used measurement system are pictured below:



The following table lists calibration dates of measurement equipment:

Test Equipment	Serial Number	Calibration interval	Calibration expiry
DAE V4	555	12 months	2008-03
R&S CMU200 Radio Communication Test Set	101111	12 months	2007-07
AM1DV3 Audio Magnetic Probe	3036	12 months	2008-02
AMMI Audio Magnetic Measurement Instrument	1002	-	-
AMCC Helmholtz Audio Magnetic Calibration Coil	1004	-	-

3.1.1 Audio Magnetic Probe AM1DV3

Construction	Fully RF shielded metal construction (RF sensitivity < -100dB)
System calibration	Calibrated using Helmholtz coil according to manufacturers instructions
Frequency range	0.1 – 20 kHz (HOX! test signal is limited to required BW of 300 to 3000 Hz, ANSI C63.19)
Sensitivity	< -50 dB A/m
Dimensions	Overall length: 290 mm; Tip diameter: 6 mm

3.1.2 Audio Magnetic Measurement Instrument AMMI

Sampling Rate	48 kHz / 24 bit
Dynamic Range	85 dB
Test Signal Generation	User selectable and predefined (via PC)
System calibration	Auto-calibration / full system calibration using AMCC with monitor output

3.1.3 Audio Magnetic Calibration Coil AMCC

Dimensions	370 x 370 x 196 mm (ANSI-C63.19 compliant)

3.1.4 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 4.1) was used to position the test device in all tests.

3.2 Verification of the System

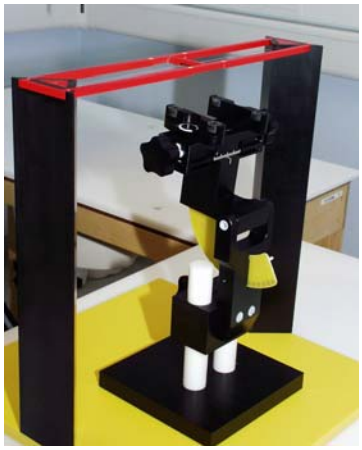
Audio Magnetic Probe AM1D is calibrated in AMCC Helmholtz Audio Magnetic Calibration Coil before each measurement procedure using calibration and reference signals.

R&S CMU200 audio codec and SPEAG AMMI audio paths (gain) were calibrated according to manufacturer's instructions.

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 positioner under Test Arch.



Device holder and Test Arch supplied by SPEAG

4.2 Test Positions

The device was positioned such that Device Reference plane was touching the bottom of the Test Arch. The acoustic output is aligned with the intersection of the Test Arch's middle bar and dielectric wire. The WD is positioned always this way to ensure repeatability of the measurements. Coordinate system depicted below is used to define exact locations of measurement points relative to the center of the acoustic output.

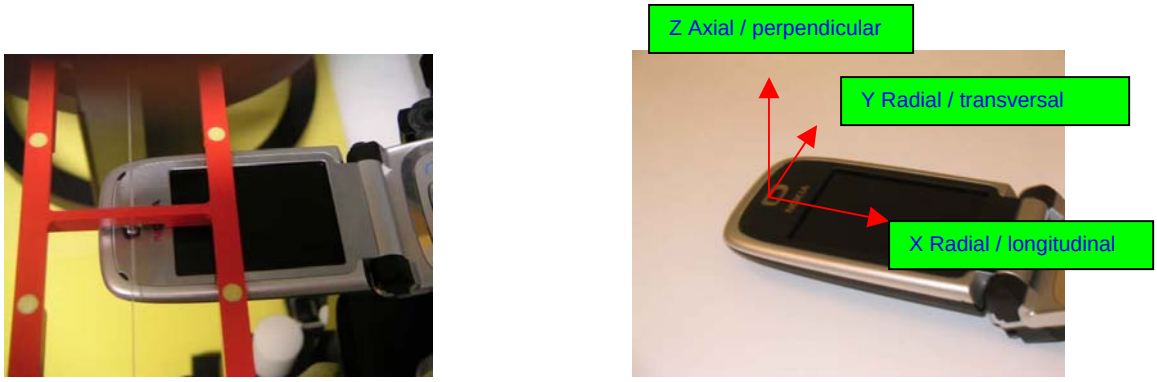


Photo of the device positioned under Test Arch and coordinate system (The EUT in picture is generic phone sample and does not represent the actual equipment under test)

4.3 T-coil Scan Procedures

Manufacturer can either define measurement locations for WD categorization or optimum locations can be found using following procedure; First, coarse scans in all measurement orientations, centered at the earpiece, are made to find approximate locations of optimum signal. More accurate fine scans are made in these locations to find final measurement points.

4.4 Measurement procedure and used test signals

During measurements signal is fed to WD via communication tester. Proper gain setting is used in software to ensure correct signal level fed to communication tester speech input. Measurement software compares fed signal and signal from measurement probe and applies proper filtering and integration procedures.

Broadband voice-like signal (300...3000Hz) is used during scans and frequency response measurement to ensure proper operation of WD vocoder and audio enhancement algorithms.

Both signal (ABM1) and undesired audio noise (ABM2) are measured consequently to enable determination of signal+noise to noise ratio (SNR).

In final measurement sine signal is used to determine signal strength @ 1025 Hz.

4.5 T-coil Requirements and Category Limits

RF Emissions

Wireless device has to fulfill RF emission requirements at the axial measurement location.

Axial Field Intensity

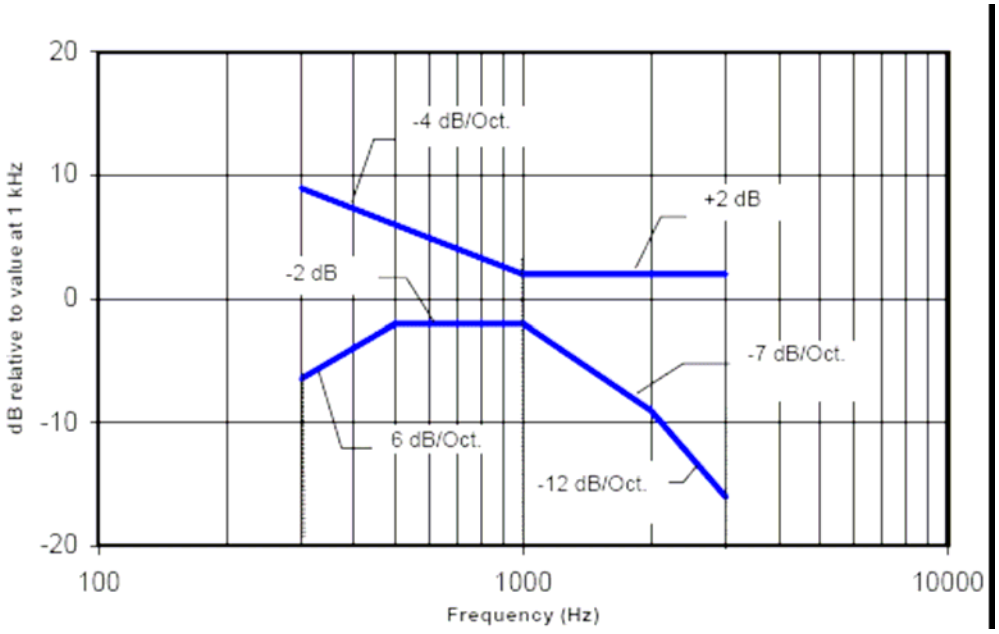
The axial component of the magnetic field shall be ≥-13dB(A/m) at 1 kHz, in 1/3 octave band filter.

Radial Field Intensity

The radial components of the magnetic field shall be ≥-18dB(A/m) at 1 kHz, in 1/3 octave band filter.

Frequency Response

Frequency response of the axial component must be between the limits pointed by frequency curves below:



Frequency response window applicable for devices with axial field strength > -10dB(A/m)

Signal Quality

The worst result of three T-coil signal measurements is used to define WD Hearing Aid T-category according to the category limits:

Category	AWF [dB]	Limits for Signal Quality [dB]
T1	0	-20
	-5	-15
T2	0	-10
	-5	-5
T3	0	0
	-5	5
T4	0	10
	-5	15

5. MEASUREMENT UNCERTAINTY

Error Description	Uncertainty value [%]	Prob. Dist.	Div.	c ABM1	c ABM2	Std. Unc. ABM1 [%]	Std. Unc. ABM2 [%]
PROBE SENSITIVITY							
Reference level	3.0	N	1.0	1	1	3.0	3.0
AMCC geometry	0.4	R	1.7	1	1	0.2	0.2
AMCC current	0.6	R	1.7	1	1	0.4	0.4
Probe positioning during calibration	0.1	R	1.7	1	1	0.1	0.1
Noise contribution	0.7	R	1.7	0.0143	1	0.0	0.4
Frequency slope	5.9	R	1.7	0.1	1.0	0.3	3.5
PROBE SYSTEM							
Repeatability / Drift	1.0	R	1.7	1	1	0.6	0.6
Linearity / Dynamic range	0.6	R	1.7	1	1	0.4	0.4
Acoustic noise	1.0	R	1.7	0.1	1	0.1	0.6
Probe angle	2.3	R	1.7	1	1	1.4	1.4
Spectral processing	0.9	R	1.7	1	1	0.5	0.5
Integration time	0.6	N	1.0	1	5	0.6	3.0
Field disturbation	0.2	R	1.7	1	1	0.1	0.1
TEST SIGNAL							
Reference signal spectral response	0.6	R	1.7	0	1	0.0	0.4
POSITIONING							
Probe positioning	1.9	R	1.7	1	1	1.1	1.1
Phantom thickness	0.9	R	1.7	1	1	0.5	0.5
DUT positioning	1.9	R	1.7	1	1	1.1	1.1
EXTERNAL CONTRIBUTIONS							
RF interference	0.0	R	1.7	1	1	0.0	0.0
Test signal variation	2.0	R	1.7	1	1	1.2	1.2
COMBINED UNCERTAINTY							
Combined Std. uncertainty (ABM field)						4.1	6.1
Expanded Std. uncertainty [%]						**8.1**	**12.3**

6. RESULTS

Measurement position coordinates are defined as deviation from earpiece center in millimeters. Coordinate system is defined in chapter 4.2

Axial measurement location was defined by the manufacturer of the device as the center of the earpiece. Maximum values for axial field are listed for informative purposes but results at earpiece center were used in evaluating T-category of the device.

GSM results

	Radial 1 (longitudinal)		Radial 2 (transversal)		Axial			
Mode	850	1900	850	1900	850		1900	
Measurement position (x,y) [mm]	-3;13	-2.8;13.2	5.6;6.8	5.8;6.8	4.2;13.6	0;4	4.2;13.8	0;4
Signal strength [dB A/m]	18.1	19.2	8.2	9.3	18.8	2.4	19.5	2.5
ABM2 [dB A/m]	-31.9	-34.8	-40.5	-39.6	-35.9	-39.0	-36.4	-36.0
Signal quality [dB]	50.0	54.0	48.7	48.9	54.7	41.4	55.9	38.5
Ambient backround noise at point (0,0) ABM [dB A/m]	-48.2	-42.0	-42.4	-42.1	-45.2	-45. 2	-42.8	-42.8

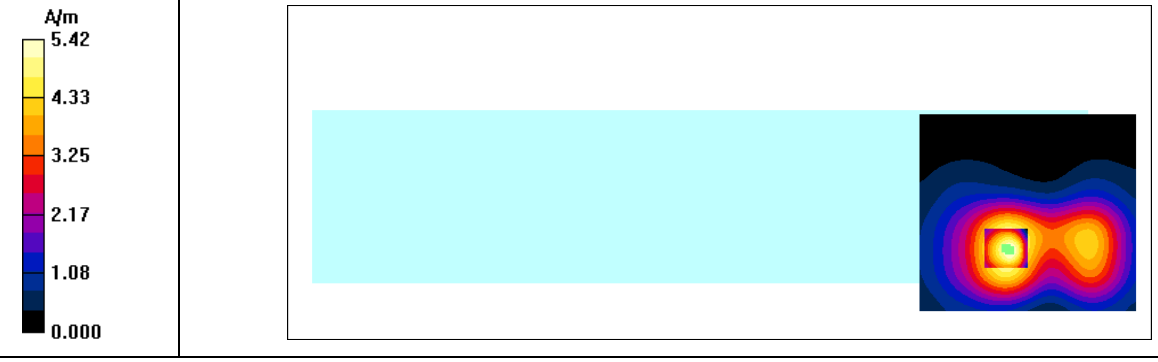
WCDMA results

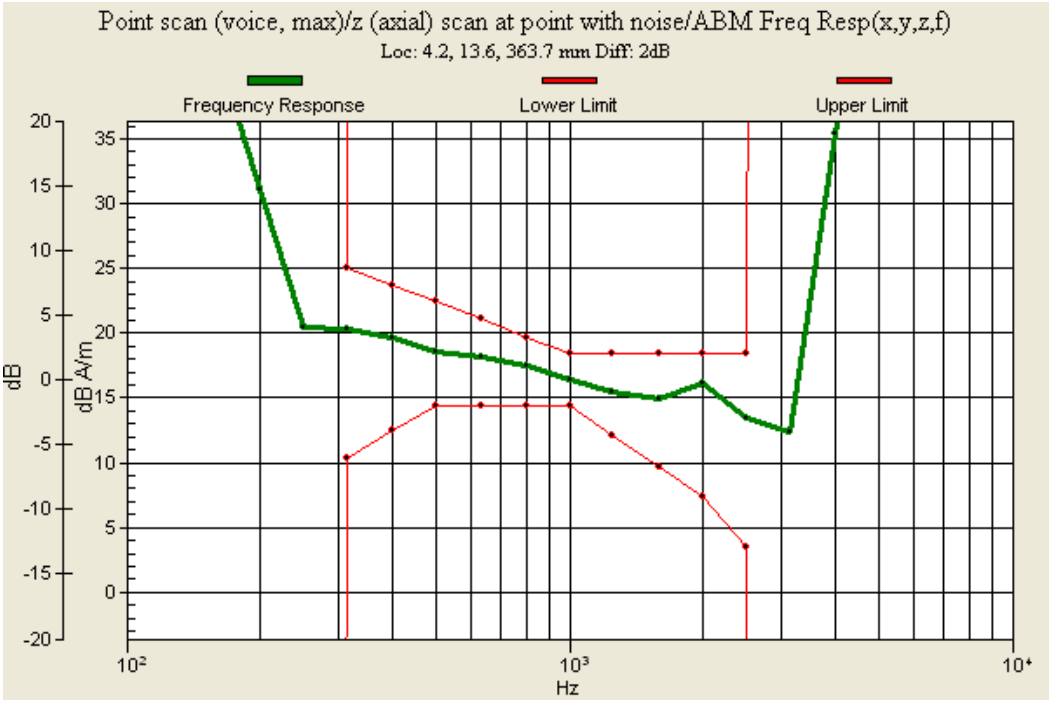
	Radial 1 (longitudinal)		Radial 2 (transversal)		Axial			
Mode	850	1900	850	1900	850		1900	
Measurement position (x,y) [mm]	-3.2;13.4	-2.6;13.2	5.2, 6.8	5.4;7.2	4.6;13.8	0;4	4;13.2	0;4
Signal strength [dB A/m]	17.3	18.2	4.9	6.8	17.3	-0.8	18.4	1.8
ABM2 [dB A/m]	-37.1	-36.3	-35.9	-38.2	-38.2	-35.6	-40.1	-39.3
Signal quality [dB]	54.4	54.6	40.9	44.9	55.3	34.8	58.6	41.1
Ambient backround noise at point (0,0) ABM [dB A/m]	-44.7	-43.2	-41.3	-39.8	-41.5	-41.5	-36.2	-36.2

Plots of the signal strength measurement scans are presented in Appendix A.

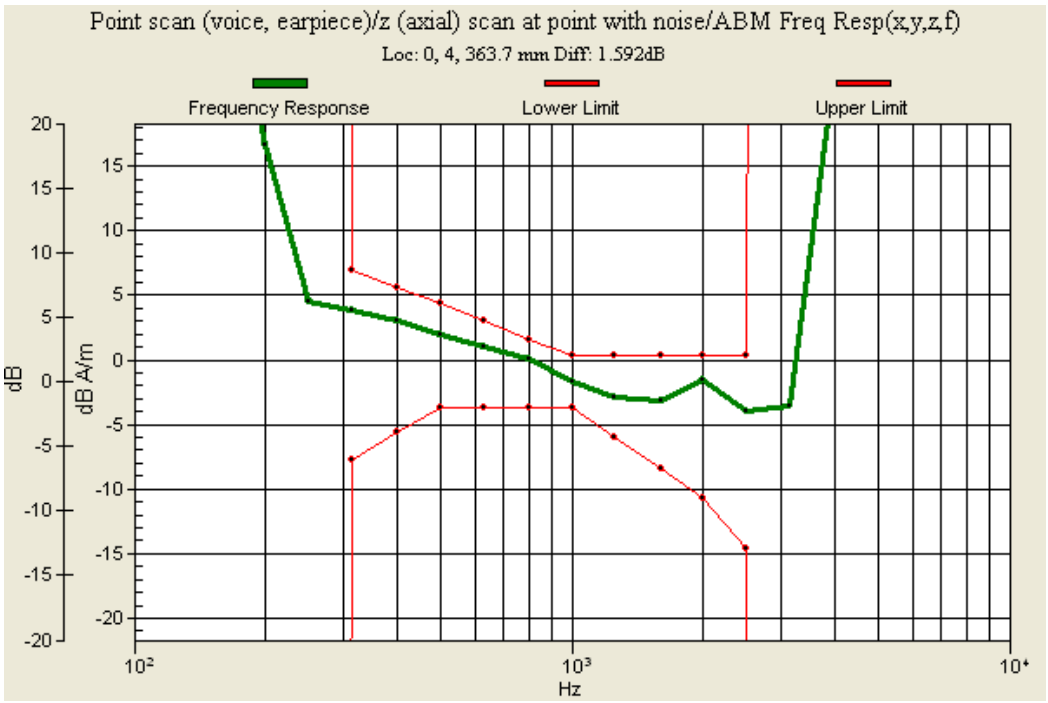
APPENDIX A: MEASUREMENT SCANS, GSM

Date/Time: 2007-04-30 13:30:43 Test Laboratory: TCC Nokia **Type: RM-289; Serial: 004400/99/176008/1** Communication System: GSM850 Frequency: 836.6 MHz; Duty Cycle: 1:7 Medium: Air; Medium Notes: Not Specified Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3 Phantom section: AMB with Coil Section	DASY4 Configuration: - Probe: AM1DV3 - 3036; Calibrated: 2007-02-16 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
Coarse scan/z (axial) scan 50 x 50 (grid 10) with noise/ABM Interpolated Signal(x,y,z) (51x51x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 = 14.6729 dB A/m BWC Factor = 10.8 dB Location: 5, 13, 363.7 mm	**Background noise 5mm above Grid Reference/z (axial) noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -45.1762 dB A/m Location: 0, 0, 368.7 mm
Fine scan/z (axial) scan 10 x 10 (grid 2) with noise/ABM Interpolated Signal(x,y,z) (51x51x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 = 16.2411 dB A/m BWC Factor = 10.8 dB Location: 4.2, 13.6, 363.7 mm	
Point scan (sinewave, max)/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 18.8213 dB A/m BWC Factor = 0.00625159 dB Location: 4.2, 13.6, 363.7 mm **Point scan (sinewave, max)/z (axial) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -35.8619 dB A/m Location: 4.2, 13.6, 363.7 mm **Point scan (sinewave, max)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 54.6832 dB BWC Factor = 0.00625159 dB Location: 4.2, 13.6, 363.7 mm	**Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 2.37317 dB A/m BWC Factor = 0.00625159 dB Location: 0, 4, 363.7 mm **Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -39.0064 dB A/m Location: 0, 4, 363.7 mm **Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 41.3796 dB BWC Factor = 0.00625159 dB Location: 0, 4, 363.7 mm



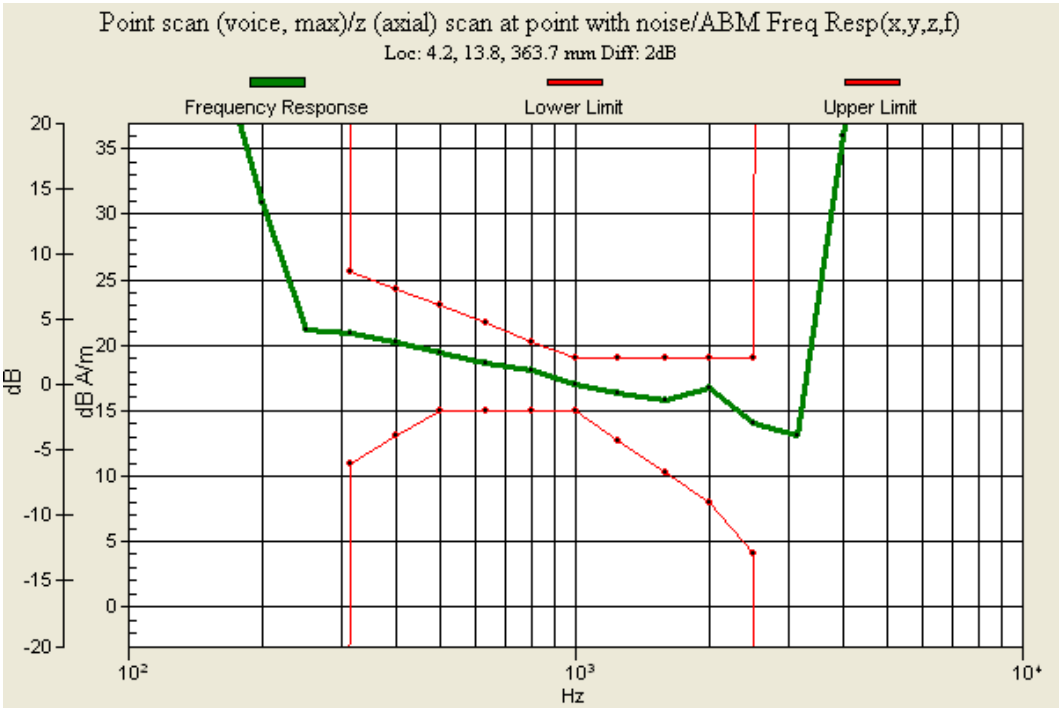


Frequency response in GSM850 mode, the point of maximum signal strength (axial)

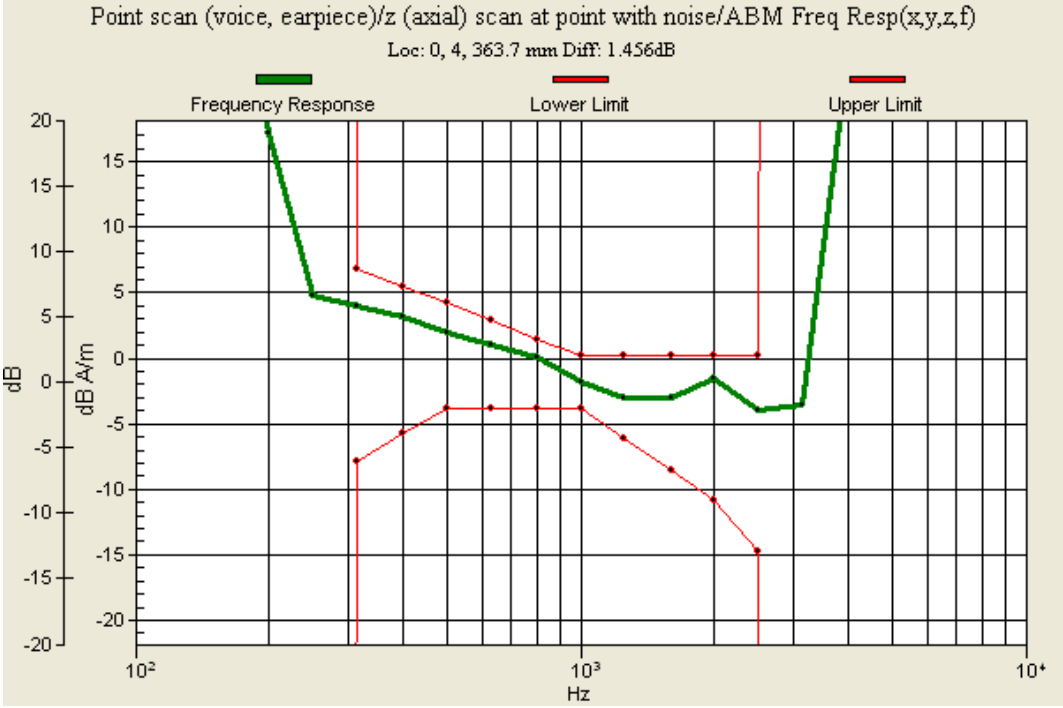


Frequency response in GSM850 mode, point 0,4 (axial)

Date/Time: 2007-05-02 9:31:03 Test Laboratory: TCC Nokia **Type: RM-289; Serial: 004400/99/176008/1** Communication System: GSM1900 Frequency: 1880 MHz; Duty Cycle: 1:8.3 Medium: Air; Medium Notes: Not Specified Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3 Phantom section: AMB with Coil Section	DASY4 Configuration: - Probe: AM1DV3 - 3036; Calibrated: 2007-02-16 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
Point scan (sinewave, max)/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 19.4653 dB A/m BWC Factor = 0.00651198 dB Location: 4.2, 13.8, 363.7 mm **Point scan (sinewave, max)/z (axial) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -36.3941 dB A/m Location: 4.2, 13.8, 363.7 mm **Point scan (sinewave, max)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 55.8594 dB BWC Factor = 0.00651198 dB Location: 4.2, 13.8, 363.7 mm	**Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 2.44618 dB A/m BWC Factor = 0.00651198 dB Location: 0, 4, 363.7 mm **Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -36.0173 dB A/m Location: 0, 4, 363.7 mm **Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 38.4635 dB BWC Factor = 0.00651198 dB Location: 0, 4, 363.7 mm
Background noise 5mm above Grid Reference/z (axial) noise/ABM Noise(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -42.8219 dB A/m Location: 0, 0, 368.7 mm	

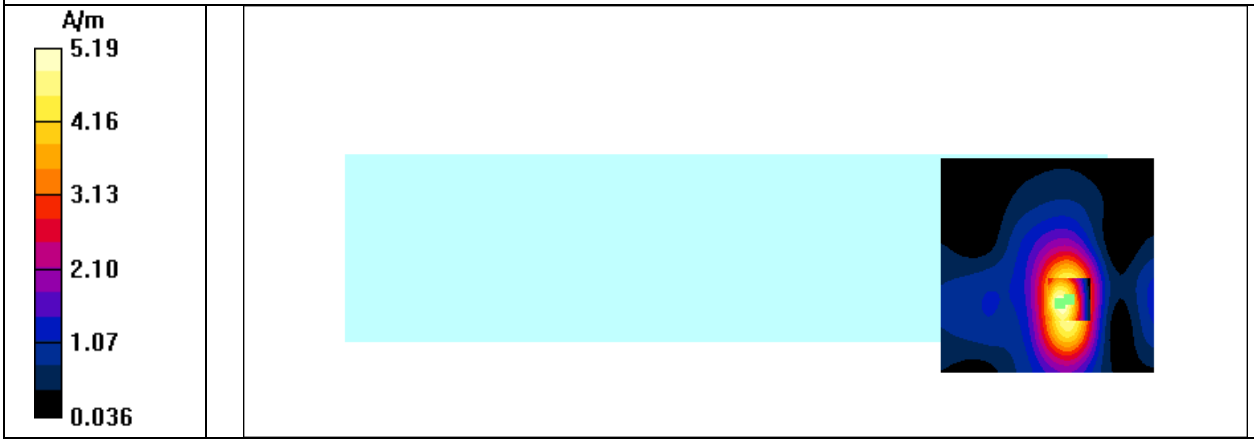


Frequency response in GSM1900 mode, the point of maximum signal strength (axial)

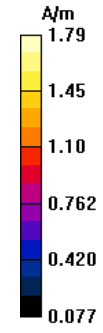
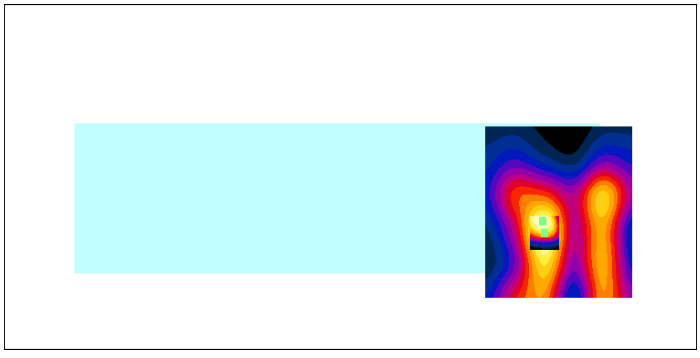


Frequency response in GSM1900 mode, point 0,4 (axial)

Date/Time: 2007-04-30 13:35:11 Test Laboratory: TCC Nokia **Type: RM-289; Serial: 004400/99/176008/1** Communication System: GSM850 Frequency: 836.6 MHz; Duty Cycle: 1:7 Medium: Air; Medium Notes: Not Specified Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3 Phantom section: AMB with Coil Section	DASY4 Configuration: - Probe: AM1DV3 - 3036; Calibrated: 2007-02-16 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
Coarse scan/x (longitudinal) scan 50 x 50 (grid 10) with noise/ABM Interpolated Signal(x,y,z) (51x51x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 = 14.3064 dB A/m BWC Factor = 10.8 dB Location: -5, 12, 363.7 mm	**Background noise 5mm above Grid Reference/x (longitudinal) noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -48.2118 dB A/m Location: 0, 0, 368.7 mm
Fine scan/x (longitudinal) scan 10 x 10 (grid 2) with noise/ABM Interpolated Signal(x,y,z) (51x51x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 = 15.7596 dB A/m BWC Factor = 10.8 dB Location: -3, 13, 363.7 mm	
Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM Signal(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 18.1033 dB A/m BWC Factor = 0.00625159 dB Location: -3, 13, 363.7 mm **Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -31.8535 dB A/m Location: -3, 13, 363.7 mm **Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 49.9568 dB BWC Factor = 0.00625159 dB Location: -3, 13, 363.7 mm	

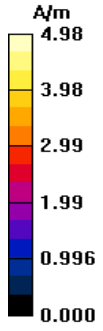
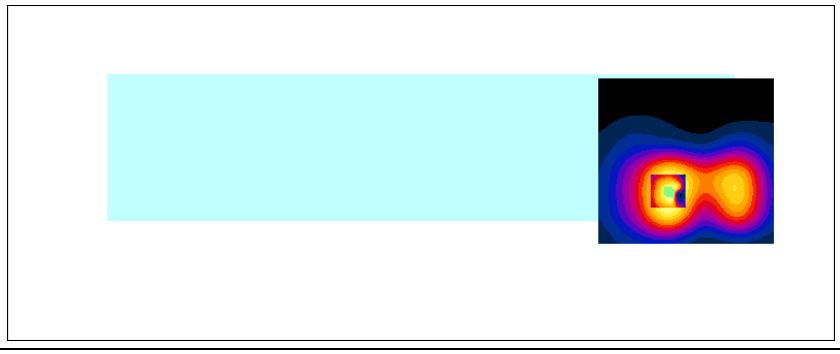


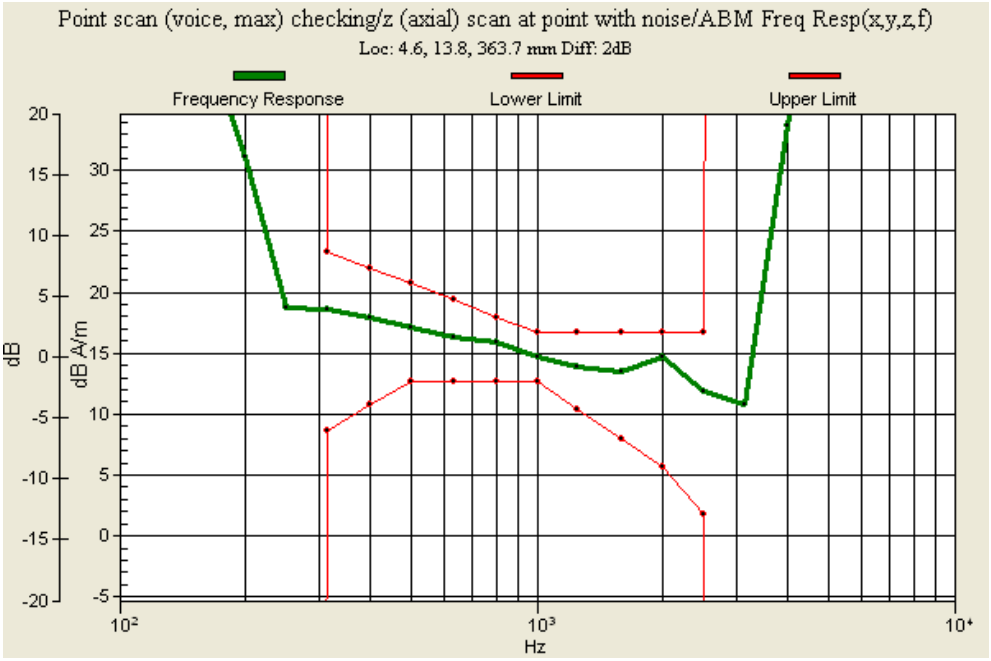
Date/Time: 2007-05-02 9:35:32 Test Laboratory: TCC Nokia **Type: RM-289; Serial: 004400/99/176008/1** Communication System: GSM1900 Frequency: 1880 MHz; Duty Cycle: 1:8.3 Medium: Air; Medium Notes: Not Specified Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3 Phantom section: AMB with Coil Section	DASY4 Configuration: - Probe: AM1DV3 - 3036; Calibrated: 2007-02-16 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM Signal(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 19.1629 dB A/m BWC Factor = 0.00651198 dB Location: -2.8, 13.2, 363.7 mm **Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -34.8102 dB A/m Location: -2.8, 13.2, 363.7 mm **Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 53.9731 dB BWC Factor = 0.00651198 dB Location: -2.8, 13.2, 363.7 mm	
Background noise 5mm above Grid Reference/x (longitudinal) noise/ABM Noise(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -42.022 dB A/m Location: 0, 0, 368.7 mm	

Date/Time: 2007-04-30 13:39:46 Test Laboratory: TCC Nokia **Type: RM-289; Serial: 004400/99/176008/1** Communication System: GSM850 Frequency: 836.6 MHz; Duty Cycle: 1:7 Medium: Air; Medium Notes: Not Specified Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3 Phantom section: AMB with Coil Section	DASY4 Configuration: - Probe: AM1DV3 - 3036; Calibrated: 2007-02-16 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
Coarse scan/y (transversal) scan 50 x 50 (grid 10) with noise/ABM Interpolated Signal(x,y,z) (51x51x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 = 5.05067 dB A/m BWC Factor = 10.8 dB Location: 5, 10, 363.7 mm	**Background noise 5mm above Grid Reference/y (transversal) noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -42.3937 dB A/m Location: 0, 0, 368.7 mm
Fine scan/y (transversal) scan 10 x 10 (grid 2) with noise/ABM Interpolated Signal(x,y,z) (51x51x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 = 5.62151 dB A/m BWC Factor = 10.8 dB Location: 5.6, 6.8, 363.7 mm	
Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM Signal(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 8.17648 dB A/m BWC Factor = 0.00625159 dB Location: 5.6, 6.8, 363.7 mm **Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -40.489 dB A/m Location: 5.6, 6.8, 363.7 mm **Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 48.6654 dB BWC Factor = 0.00625159 dB Location: 5.6, 6.8, 363.7 mm	
	

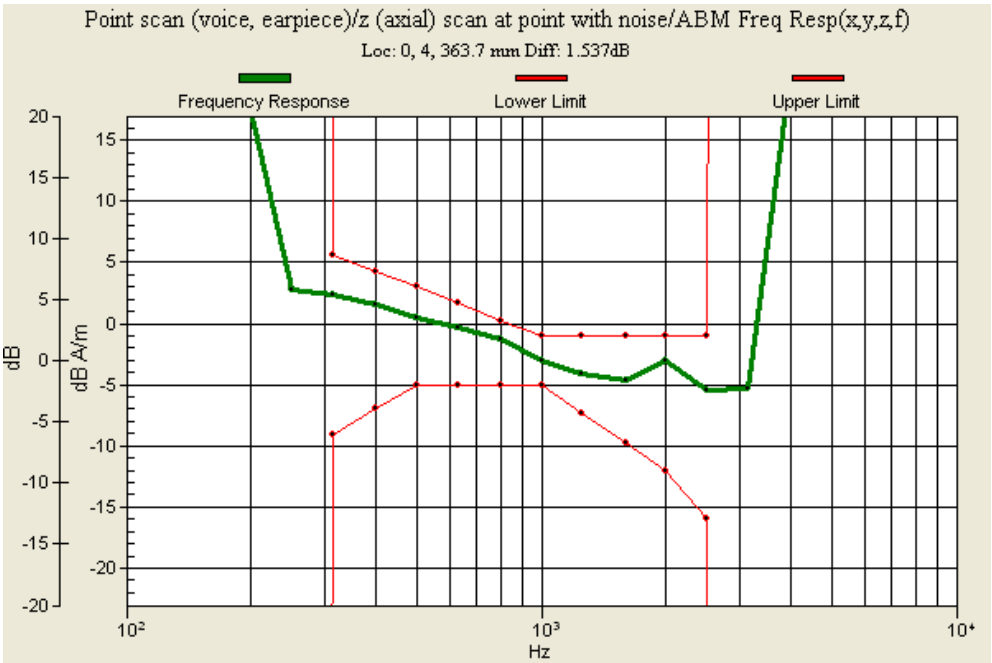
Date/Time: 2007-05-02 9:40:08 Test Laboratory: TCC Nokia **Type: RM-289; Serial: 004400/99/176008/1** Communication System: GSM1900 Frequency: 1880 MHz; Duty Cycle: 1:8.3 Medium: Air; Medium Notes: Not Specified Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3 Phantom section: AMB with Coil Section	DASY4 Configuration: - Probe: AM1DV3 - 3036; Calibrated: 2007-02-16 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM Signal(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 9.27438 dB A/m BWC Factor = 0.00651198 dB Location: 5.8, 6.8, 363.7 mm **Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -39.6178 dB A/m Location: 5.8, 6.8, 363.7 mm **Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 48.8922 dB BWC Factor = 0.00651198 dB Location: 5.8, 6.8, 363.7 mm	
Background noise 5mm above Grid Reference/y (transversal) noise/ABM Noise(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -42.1258 dB A/m Location: 0, 0, 368.7 mm	

APPENDIX B: MEASUREMENT SCANS, WCDMA

Date/Time: 2007-05-02 12:46:13 Test Laboratory: TCC Nokia **Type: RM-289; Serial: 004400/99/176008/1** Communication System: US WCDMA850 Frequency: 835 MHz; Duty Cycle: 1:1 Medium: Air; Medium Notes: Not Specified Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3 Phantom section: AMB with Coil Section	DASY4 Configuration: - Probe: AM1DV3 - 3036; Calibrated: 2007-02-16 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
Coarse scan/z (axial) scan 50 x 50 (grid 10) with noise/ABM Interpolated Signal(x,y,z) (51x51x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 = 13.953 dB A/m BWC Factor = 10.8 dB Location: 5, 13, 363.7 mm	**Background noise 5mm above Grid Reference/z (axial) noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -41.546 dB A/m Location: 0, 0, 368.7 mm
Fine scan/z (axial) scan 10 x 10 (grid 2) with noise/ABM Interpolated Signal(x,y,z) (51x51x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 = 15.734 dB A/m BWC Factor = 10.8 dB Location: 4.6, 13.8, 363.7 mm	
Point scan (sinewave, max)/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 17.1333 dB A/m BWC Factor = 0.0057308 dB Location: 4.6, 13.8, 363.7 mm **Point scan (sinewave, max)/z (axial) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -38.1882 dB A/m Location: 4.6, 13.8, 363.7 mm **Point scan (sinewave, max)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 55.3215 dB BWC Factor = 0.0057308 dB Location: 4.6, 13.8, 363.7 mm	**Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = -0.846555 dB A/m BWC Factor = 0.00616479 dB Location: 0, 4, 363.7 mm **Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -35.6331 dB A/m Location: 0, 4, 363.7 mm **Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 34.7866 dB BWC Factor = 0.00616479 dB Location: 0, 4, 363.7 mm
	

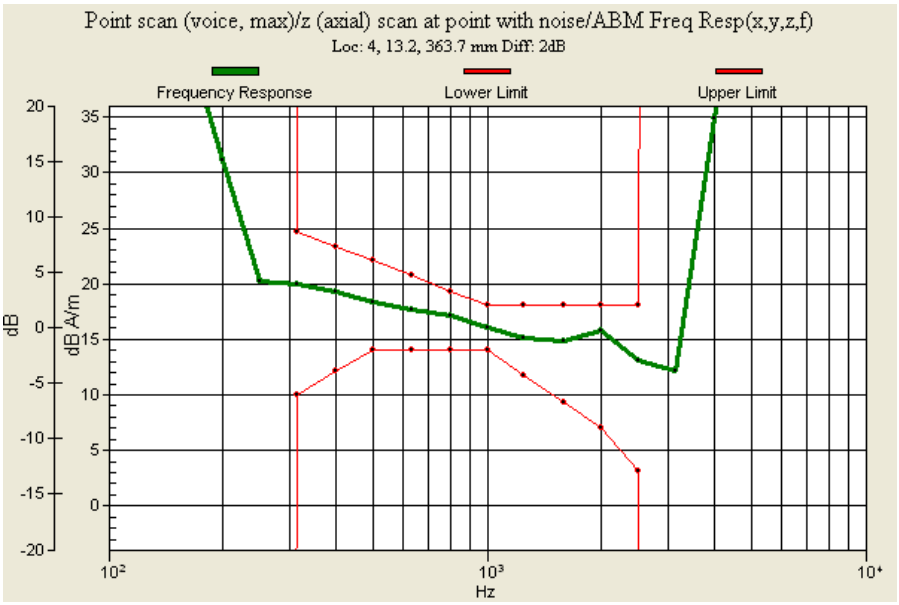


Frequency response in WCDMA850 mode, the point of maximum signal strength (axial)

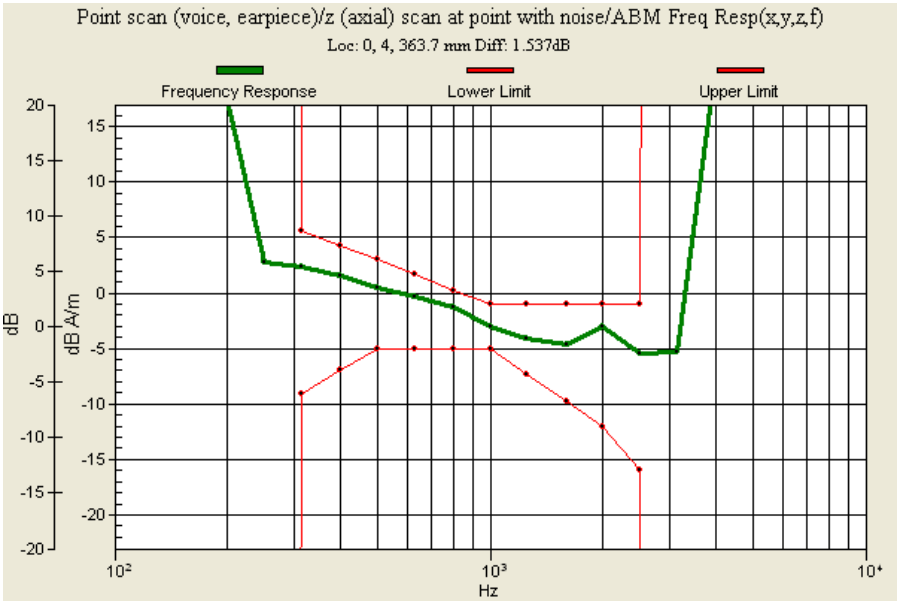


Frequency response in WCDMA850 mode, point 0,4 (axial)

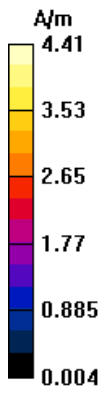
Date/Time: 2007-05-02 11:15:40 Test Laboratory: TCC Nokia **Type: RM-289; Serial: 004400/99/176008/1** Communication System: US WCDMA1900 Frequency: 1880 MHz; Duty Cycle: 1:1 Medium: Air; Medium Notes: Not Specified Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3 Phantom section: AMB with Coil Section	DASY4 Configuration: - Probe: AM1DV3 - 3036; Calibrated: 2007-02-16 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
Point scan (sinewave, max)/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 18.4184 dB A/m BWC Factor = 0.0058176 dB Location: 4, 13.2, 363.7 mm **Point scan (sinewave, max)/z (axial) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -40.1493 dB A/m Location: 4, 13.2, 363.7 mm **Point scan (sinewave, max)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 58.5677 dB BWC Factor = 0.0058176 dB Location: 4, 13.2, 363.7 mm	**Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 1.82002 dB A/m BWC Factor = 0.00538358 dB Location: 0, 4, 363.7 mm **Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -39.2713 dB A/m Location: 0, 4, 363.7 mm **Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 41.0913 dB BWC Factor = 0.00538358 dB Location: 0, 4, 363.7 mm
Background noise 5mm above Grid Reference/z (axial) noise/ABM Noise(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -36.2345 dB A/m Location: 0, 0, 368.7 mm	



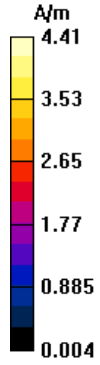
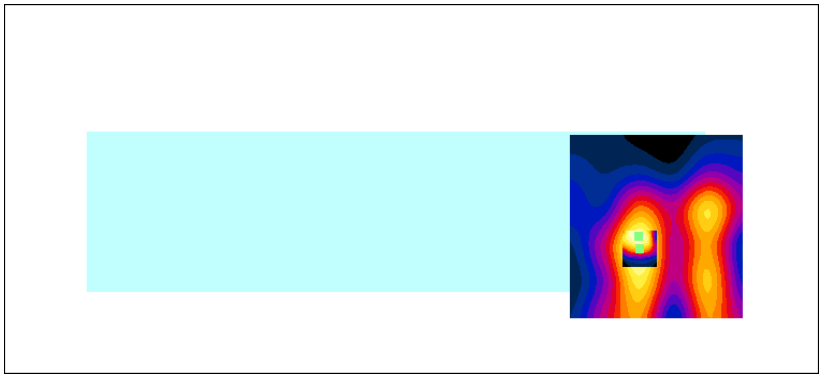
Frequency response in WCDMA1900 mode, the point of maximum signal strength (axial)



Frequency response in WCDMA1900 mode, point 0,4 (axial)

Date/Time: 2007-05-02 12:50:41 Test Laboratory: TCC Nokia **Type: RM-289; Serial: 004400/99/176008/1** Communication System: US WCDMA850 Frequency: 835 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: AMB with Coil Section	DASY4 Configuration: - Probe: AM1DV3 - 3036; Calibrated: 2007-02-16 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
Coarse scan/x (longitudinal) scan 50 x 50 (grid 10) with noise/ABM Interpolated Signal(x,y,z) (51x51x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 = 12.8871 dB A/m BWC Factor = 10.8 dB Location: -5, 19, 363.7 mm	**Background noise 5mm above Grid Reference/x (longitudinal) noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -44.6911 dB A/m Location: 0, 0, 368.7 mm
Fine scan/x (longitudinal) scan 10 x 10 (grid 2) with noise/ABM Interpolated Signal(x,y,z) (51x61x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 = 15.559 dB A/m BWC Factor = 10.8 dB Location: -3.2, 13.4, 363.7 mm	
Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM Signal(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 17.3171 dB A/m BWC Factor = 0.0057308 dB Location: -3.2, 13.4, 363.7 mm **Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -37.0796 dB A/m Location: -3.2, 13.4, 363.7 mm **Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 54.3967 dB BWC Factor = 0.0057308 dB Location: -3.2, 13.4, 363.7 mm	
	

Date/Time: 2007-05-02 11:20:09 Test Laboratory: TCC Nokia **Type: RM-289; Serial: 004400/99/176008/1** Communication System: US WCDMA1900 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: AMB with Coil Section	DASY4 Configuration: - Probe: AM1DV3 - 3036; Calibrated: 2007-02-16 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM Signal(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 18.1585 dB A/m BWC Factor = 0.0058176 dB Location: -2.6, 13.2, 363.7 mm **Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -36.3471 dB A/m Location: -2.6, 13.2, 363.7 mm **Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 54.5056 dB BWC Factor = 0.0058176 dB Location: -2.6, 13.2, 363.7 mm	
Background noise 5mm above Grid Reference/x (longitudinal) noise/ABM Noise(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -43.1438 dB A/m Location: 0, 0, 368.7 mm	

Date/Time: 2007-05-02 12:55:17 Test Laboratory: TCC Nokia **Type: RM-289; Serial: 004400/99/176008/1** Communication System: US WCDMA850 Frequency: 835 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: AMB with Coil Section	DASY4 Configuration: - Probe: AM1DV3 - 3036; Calibrated: 2007-02-16 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
Coarse scan/y (transversal) scan 50 x 50 (grid 10) with noise/ABM Interpolated Signal(x,y,z) (51x51x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 = 4.5133 dB A/m BWC Factor = 10.8 dB Location: 5, 10, 363.7 mm	**Background noise 5mm above Grid Reference/y (transversal) noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -41.283 dB A/m Location: 0, 0, 368.7 mm
Fine scan/y (transversal) scan 10 x 10 (grid 2) with noise/ABM Interpolated Signal(x,y,z) (51x51x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 = 5.37276 dB A/m BWC Factor = 10.8 dB Location: 5.2, 6.8, 363.7 mm	
Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM Signal(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 4.94247 dB A/m BWC Factor = 0.0057308 dB Location: 5.2, 6.8, 363.7 mm **Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -35.9489 dB A/m Location: 5.2, 6.8, 363.7 mm **Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 40.8914 dB BWC Factor = 0.0057308 dB Location: 5.2, 6.8, 363.7 mm	
	

Date/Time: 2007-05-02 11:24:45 Test Laboratory: TCC Nokia **Type: RM-289; Serial: 004400/99/176008/1** Communication System: US WCDMA1900 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: AMB with Coil Section	DASY4 Configuration: - Probe: AM1DV3 – 3036; Calibrated: 16.2.2007 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn555; Calibrated: 2007-03-15 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172
Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM Signal(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1 comp = 6.78984 dB A/m BWC Factor = 0.0058176 dB Location: 5.4, 7.2, 363.7 mm **Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM Noise(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -38.2041 dB A/m Location: 5.4, 7.2, 363.7 mm **Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM1/ABM2 = 44.994 dB BWC Factor = 0.0058176 dB Location: 5.4, 7.2, 363.7 mm	
Background noise 5mm above Grid Reference/y (transversal) noise/ABM Noise(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm **Cursor:** ABM2 = -39.8128 dB A/m Location: 0, 0, 368.7 mm	

APPENDIX C: AUDIO MAGNETIC PROBE AM1DV3 S/N 3036 CALIBRATION DOCUMENT

APPENDIX D: R&S CMU200 CALIBRATION DOCUMENT