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HAC T-Coil Signal Test Report

Test report no.:	T-Coil_RM-717_02	**Date of report:**	2010-09-16
Template version:	5.0	**Number of pages:**	20
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Responsible test engineer:	Heikki Haloila	**Product contact person:**	Qiu Rain
Measurements made by:	Heikki Haloila		
Tested devices:	RM-717 (Hearing aid mode active)		
FCC ID:	QTLRM-717	**IC:**	661AB-RM717
Supplement reports:	RF_RM-717_01, HAC_Photo_RM-717_03		
Testing has been carried out in accordance with:	**ANSI C63.19-2007** 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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1. SUMMARY OF HAC T-COIL SIGNAL TEST REPORT

1.1 Test Details

Period of test	2010-09-09 to 2010-09-10
SN, HW, SW and DUT numbers of tested device	SN: 004402/13/169803/1, HW: 0202, SW: tw92_10w31SSC, DUT: 14968
Batteries used in testing	TYPE: BL-5C, DUT: 14962, 14963
State of sample	Prototype unit
Notes	AWF = -5 for GSM

1.2 Summary of T-Coil Test Results

1.2.1 T-Coil Coupling Field Intensity

1.2.1.1 Axial Field Intensity (z)

Mode	Minimum limit [dB (A/m)]	Result [dB (A/m)]	Verdict
GSM850	-18	21.7	Pass
GSM1900		21.7	Pass

1.2.1.2 Longitudal Field Intensity (x)

Mode	Minimum limit [dB (A/m)]	Result [dB (A/m)]	Verdict
GSM850	-18	17.5	Pass
GSM1900		17.6	Pass

1.2.1.3 Transversal Field Intensity (y)

Mode	Minimum limit [dB (A/m)]	Result [dB (A/m)]	Verdict
GSM850	-18	27.8	Pass
GSM1900		28.0	Pass

1.2.2 Frequency Response at Axial Measurement Point

Mode	Verdict
GSM850	Pass
GSM1900	Pass

1.2.3 Signal Quality

Mode	Minimum limit [dB]				Minimum result [dB]	Category assessment
	T1	T2	T3	T4		
GSM850	0	10	20	30	44.8	**T4**
GSM1900	0	10	20	30	47.3	**T4**

1.2.4 Overall HAC rating of the tested device

Mode	RF emissions category at T-coil axial measurement point (E- and H-fields)*	Category assessment, T-Coil signal quality	Combined HAC category of the tested device
GSM850	**M3**	**T4**	**M3/T4**
GSM1900	**M3**	**T4**	

*See separate HAC RF report

2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

Modes of Operation	Bands	Modulation Mode	Duty Cycle	Transmitter Frequency Range [MHz]
GSM	850 1900	GMSK	1/8	824 – 849 1850 – 1910

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

2.1 Picture Of The Device

See separate report HAC_Photo_RM-717_03.

3. TEST CONDITIONS

3.1 Temperature and Humidity

Ambient temperature (°C):	20.4 to 21.7
Ambient humidity (RH %):	52 to 63

3.2 Device Control and Parameters

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.

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

T-Coil mode was switched on from the device user interface, volume setting was set to maximum and microphone was muted.

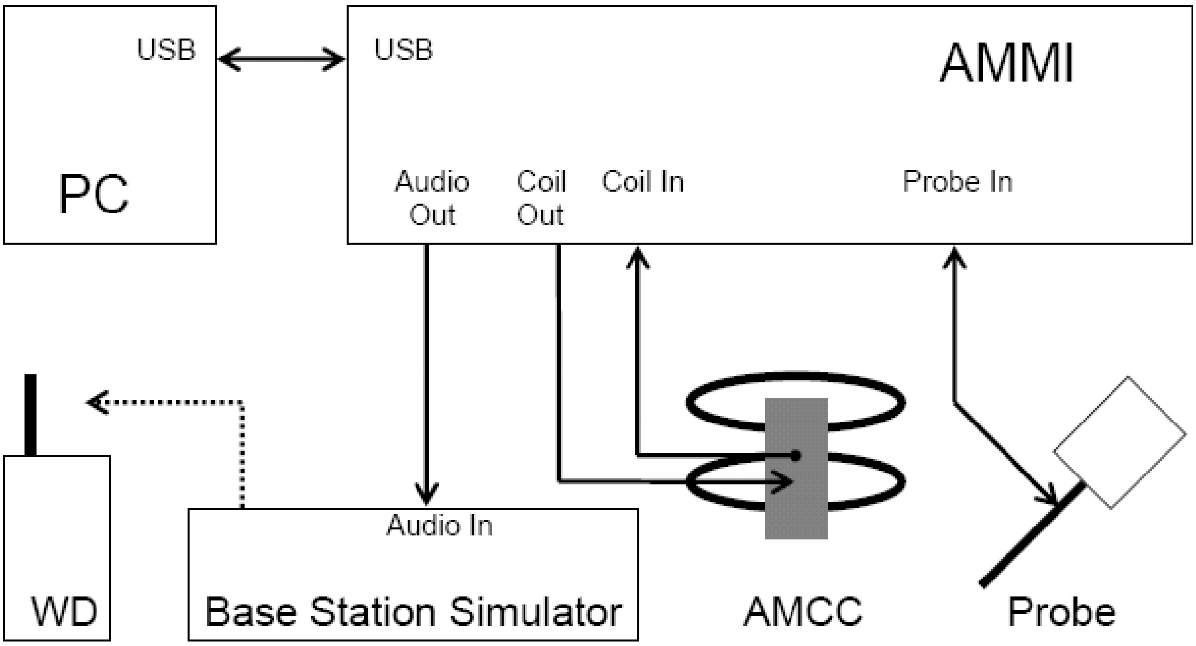
In all operating bands the measurements were performed on middle channel.

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 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
R&S CMU200 Radio Communication Test Set	101111	-	-
AM1DV3 Audio Magnetic Probe	3057	12 months	2010-10
AMMI Audio Magnetic Measurement Instrument	1002	-	-
AMCC Helmholtz Audio Magnetic Calibration Coil	1004	-	-

4.1.1 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

4.1.2 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

4.1.3 Audio Magnetic Calibration Coil AMCC

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

4.1.4 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 5.1) was used to position the test device in all tests.

4.2 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.

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 positioner under Test Arch.

Device holder and Test Arch supplied by SPEAG

5.2 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.

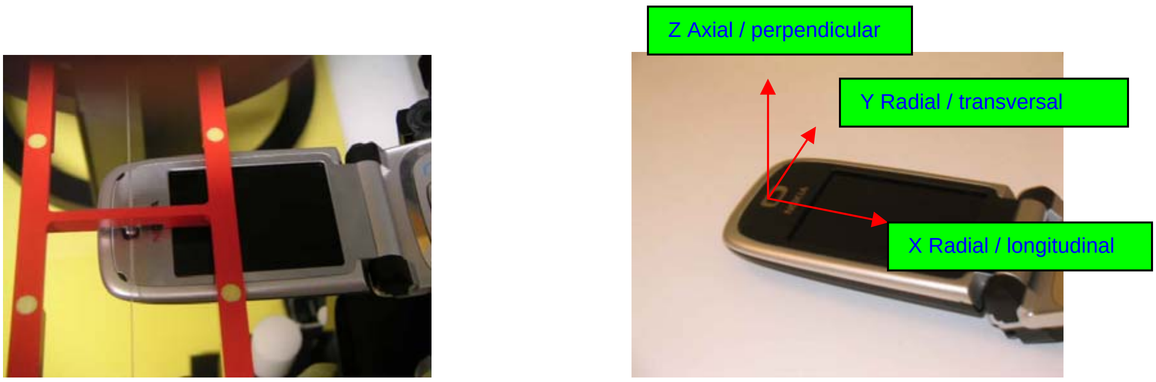


Photo of the device positioned under Test Arch and coordinate system (The EUT in picture is generic phone sample and does not represent the actual equipment under test)

5.3 T-Coil Scan Procedures and Used Test Signals

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.

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.

5.4 T-Coil Requirements and Category Limits

RF Emissions

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

Axial, Longitudal and Transversal Field Intensity

T-Coil signal magnetic field shall be ≥-18dB(A/m) at 1 kHz, in 1/3 octave band filter for all orientations.

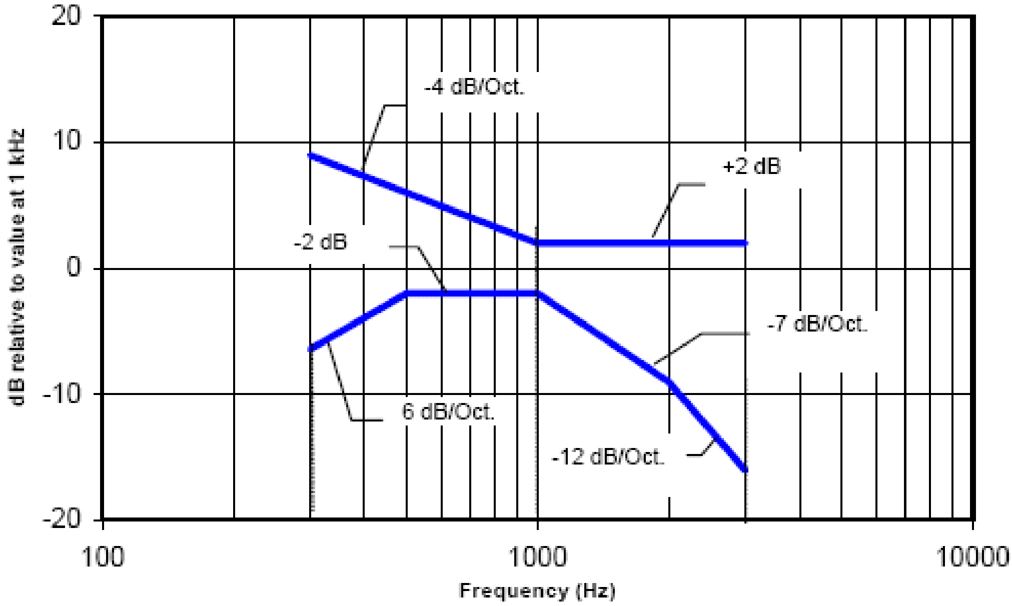
Signal Quality

The worst result of three T-Coil signal measurements is used to determine the T-Coil mode category:

Category	T1	T2	T3	T4
Limits for Signal Quality	0	10	20	30

Frequency Response

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



Magnetic field frequency response for devices with a field that exceeds -15dB (A/m) @ 1kHz.

6. MEASUREMENT UNCERTAINTY

Source of Uncertainty	Tolerance ±%	Probability Distribution	Div.	c ABM1	c ABM2	Standard Uncertainty ±%, ABM1	Standard Uncertainty ±%, ABM2
PROBE SENSITIVITY							
Reference level	3.0	N	1.0	1	1	3.0	3.0
AMCC geometry	0.4	R	√3	1	1	0.2	0.2
AMCC current	0.6	R	√3	1	1	0.4	0.4
Probe positioning during calibration	0.1	R	√3	1	1	0.1	0.1
Noise contribution	0.7	R	√3	0.0143	1	0.0	0.4
Frequency slope	5.9	R	√3	0.1	1.0	0.3	3.5
PROBE SYSTEM							
Repeatability / Drift	1.0	R	√3	1	1	0.6	0.6
Linearity / Dynamic range	0.6	R	√3	1	1	0.4	0.4
Acoustic noise	1.0	R	√3	0.1	1	0.1	0.6
Probe angle	2.3	R	√3	1	1	1.4	1.4
Spectral processing	0.9	R	√3	1	1	0.5	0.5
Integration time	0.6	N	1.0	1	5	0.6	3.0
Field disturbation	0.2	R	√3	1	1	0.1	0.1
TEST SIGNAL							
Reference signal spectral response	0.6	R	√3	0	1	0.0	0.4
POSITIONING							
Probe positioning	1.9	R	√3	1	1	1.1	1.1
Phantom thickness	0.9	R	√3	1	1	0.5	0.5
EUT Positioning	1.9	R	√3	1	1	1.1	1.1
EXTERNAL CONTRIBUTIONS							
RF interference	0.0	R	√3	1	1	0.0	0.0
Test signal variation	2.0	R	√3	1	1	1.2	1.2
COMBINED UNCERTAINTY							
Combined Standard Uncertainty (ABM field)						4.1	6.1
Expanded Standard Uncertainty [%]						**8.1**	**12.3**

7. RESULTS

Measurement location 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 although results at earpiece center were used in evaluating T-category of the device.

GSM850 results

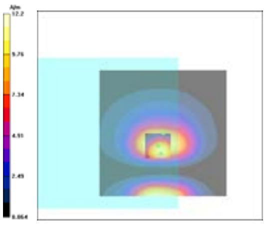
	Longitudinal (x)		Transversal (y)		Axial (z)			
					Max signal		**Earpiece**	
	x	y	x	y	x	y	x	y
Measurement location (x,y) [mm]	-6.6	6.8	0.8	15.0	0.8	8.2	0.0	0.0
Signal strength [dB A/m]	17.5		27.8		27.7		21.7	
ABM2 [dB A/m]	-27.3		-27.9		-20.7		-21.7	
Signal quality [dB]	44.8		55.7		48.4		43.4	
Ambient background noise at point (0,0) ABM [dB A/m]	-53.9		-54.2		-53.7		-53.7	

GSM1900 results

	Longitudinal (x)		Transversal (y)		Axial (z)			
					Max signal		**Earpiece**	
	x	y	x	y	x	y	x	y
Measurement location (x,y) [mm]	-6.6	6.8	0.8	15.0	0.8	8.2	0.0	0.0
Signal strength [dB A/m]	17.6		28.0		27.8		21.7	
ABM2 [dB A/m]	-29.7		-28.6		-22.9		-24.2	
Signal quality [dB]	47.3		56.6		50.7		45.9	
Ambient background noise at point (0,0) ABM [dB A/m]	-53.9		-54.2		-53.7		-53.7	

Plots of the measurement scans are presented in Appendix A.

APPENDIX A: MEASUREMENT SCANS

Axial Measurements, GSM850	
Date/Time: 2010-09-09 13:22:30 Test Laboratory: TCC Nokia **Type: RM-717; Serial: 004402/13/169803/1** Communication System: T3 measurement Frequency: 836.6 MHz; Medium: Air; Medium Notes: - 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 - 3057 - ; Calibrated: 2009-10-28 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn1213; Calibrated: 2009-11-16 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 184
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 Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav Output Gain: 72.7 Measure Window Start: 0ms Measure Window Length: 2000ms BWC applied: 10.8 dB Device Reference Point: 0.000, 0.000, 353.7 mm ABM1 = 21.7 dB A/m BWC Factor = 10.8 dB Location: 2, 5, 363.7 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 Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav Output Gain: 72.7 Measure Window Start: 0ms Measure Window Length: 2000ms BWC applied: 10.8 dB Device Reference Point: 0.000, 0.000, 353.7 mm ABM1 = 23.8 dB A/m BWC Factor = 10.8 dB Location: 0.8, 8.2, 363.7 mm
Point scan - Sinewave (Z-, X- and Y-scan @ MAX + Z-scan @ Acoustic Output)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm Signal Type: Audio File (.wav) 48k_1.025kHz_10s.wav Output Gain: 8.53 Measure Window Start: 0ms Measure Window Length: 10000ms BWC applied: 0.0145801 dB Device Reference Point: 0.000, 0.000, 353.7 mm ABM1/ABM2 = 48.4 dB ABM1 comp = 27.7 dB A/m BWC Factor = 0.0145801 dB Location: 0.8, 8.2, 363.7 mm	**Point scan - Sinewave (Z-, X- and Y-scan @ MAX + Z-scan @ Acoustic Output)/z (axial) scan at point of ACOUSTIC OUTPUT with noise/ABM SNR(x,y,z) (1x1x1):** Measurement grid: dx=10mm, dy=10mm Signal Type: Audio File (.wav) 48k_1.025kHz_10s.wav Output Gain: 8.53 Measure Window Start: 0ms Measure Window Length: 10000ms BWC applied: 0.0145801 dB Device Reference Point: 0.000, 0.000, 353.7 mm ABM1/ABM2 = 43.4 dB ABM1 comp = 21.7 dB A/m BWC Factor = 0.0145801 dB Location: 0, 0, 363.7 mm
	
Background Noise - 5mm Above Grid Reference/z (axial) noise/ABM Noise(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm, Signal Type: Off, Output Gain: 100, Measure Window Start: 2000ms Measure Window Length: 5000ms ,Device Reference Point: 0.000, 0.000, 353.7 mm ABM2 = -53.7 dB A/m Location: 0, 0, 368.7 mm	

Axial Measurements, GSM1900

Date/Time: 2010-09-10 09:11:42

Test Laboratory: TCC Nokia
Type: RM-717; Serial: 004402/13/169803/1
Communication System: T3 measurement
Frequency: 1880 MHz;
Medium: Air; Medium Notes: -
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 - 3057
- ; Calibrated: 2009-10-28
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1213; Calibrated: 2009-11-16
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 184

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
Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav
Output Gain: 72.7
Measure Window Start: 0ms
Measure Window Length: 2000ms
BWC applied: 10.8 dB
Device Reference Point: 0.000, 0.000, 353.7 mm

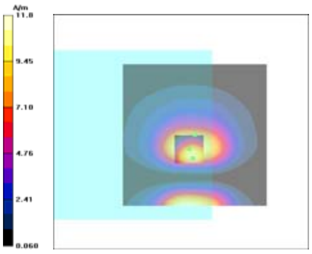
ABM1 = 21.5 dB A/m
BWC Factor = 10.8 dB
Location: 2, 5, 363.7 mm

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
Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav
Output Gain: 72.7
Measure Window Start: 0ms
Measure Window Length: 2000ms
BWC applied: 10.8 dB
Device Reference Point: 0.000, 0.000, 353.7 mm

ABM1 = 23.8 dB A/m
BWC Factor = 10.8 dB
Location: 0.6, 8.2, 363.7 mm

Point scan - Sinewave (Z-, X- and Y-scan @ MAX + Z-scan @ Acoustic Output)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_1.025kHz_10s.wav
Output Gain: 8.53
Measure Window Start: 0ms
Measure Window Length: 10000ms
BWC applied: 0.0184813 dB
Device Reference Point: 0.000, 0.000, 353.7 mm
ABM1/ABM2 = 50.7 dB
ABM1 comp = 27.8 dB A/m
BWC Factor = 0.0184813 dB
Location: 0.8, 8.2, 363.7 mm

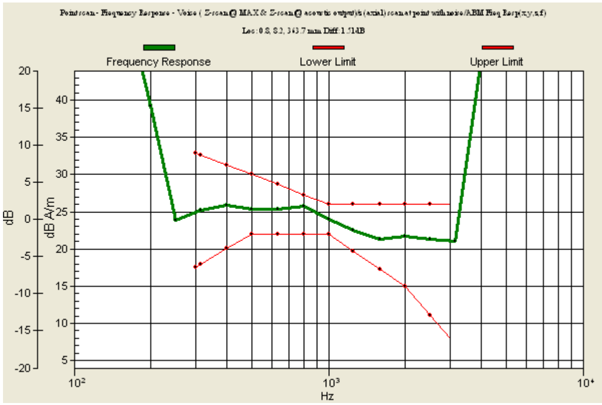
Point scan - Sinewave (Z-, X- and Y-scan @ MAX + Z-scan @ Acoustic Output)/z (axial) scan at point of ACOUSTIC OUTPUT with noise/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_1.025kHz_10s.wav
Output Gain: 8.53
Measure Window Start: 0ms
Measure Window Length: 10000ms
BWC applied: 0.0184813 dB
Device Reference Point: 0.000, 0.000, 353.7 mm
ABM1/ABM2 = 45.9 dB
ABM1 comp = 21.7 dB A/m
BWC Factor = 0.0184813 dB
Location: 0, 0, 363.7 mm



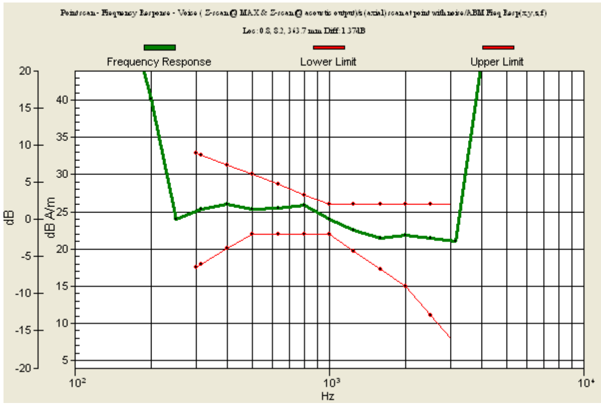
Background Noise - 5mm Above Grid Reference/z (axial) noise/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm, Signal Type: Off, Output Gain: 100, Measure Window Start: 2000ms
Measure Window Length: 5000ms ,Device Reference Point: 0.000, 0.000, 353.7 mm

ABM2 = -53.7 dB A/m
Location: 0, 0, 368.7 mm

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

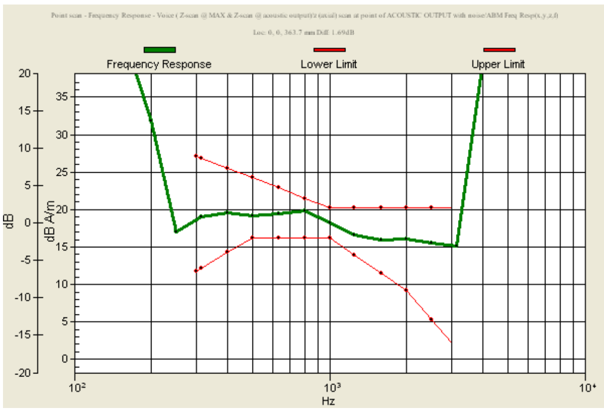


GSM850

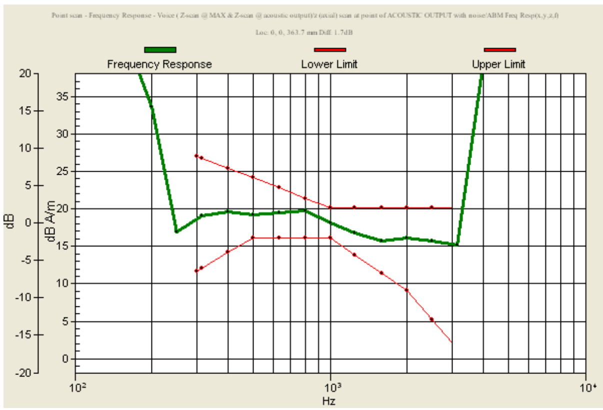


GSM1900

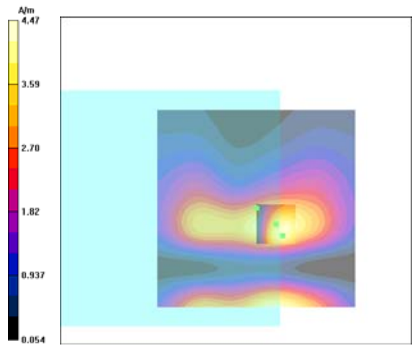
Frequency response over earpiece, point 0,0 (axial)

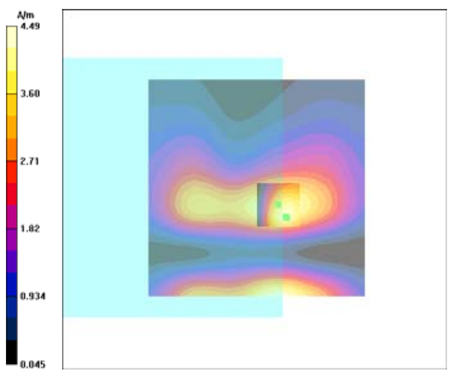


GSM850



GSM1900

Longitudal Measurements, GSM850	
Date/Time: 2010-09-09 13:27:09 Test Laboratory: TCC Nokia **Type: RM-717; Serial: 004402/13/169803/1** Communication System: T3 measurement Frequency: 836.6 MHz; Medium: Air; Medium Notes: - 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 - 3057 - ; Calibrated: 2009-10-28 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn1213; Calibrated: 2009-11-16 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 184
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 Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav Output Gain: 72.7 Measure Window Start: 0ms Measure Window Length: 2000ms BWC applied: 10.8 dB Device Reference Point: 0.000, 0.000, 353.7 mm ABM1 = 13.0 dB A/m BWC Factor = 10.8 dB Location: -5, 4, 363.7 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 Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav Output Gain: 72.7 Measure Window Start: 0ms Measure Window Length: 2000ms BWC applied: 10.8 dB Device Reference Point: 0.000, 0.000, 353.7 mm ABM1 = 13.9 dB A/m BWC Factor = 10.8 dB Location: -6.6, 6.8, 363.7 mm
Point scan - Sinewave (Z-, X- and Y-scan @ MAX + Z-scan @ Acoustic Output)/x (longitudinal) scan at point with noise/ABM SNR(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm Signal Type: Audio File (.wav) 48k_1.025kHz_10s.wav Output Gain: 8.53 Measure Window Start: 0ms Measure Window Length: 10000ms BWC applied: 0.0145801 dB Device Reference Point: 0.000, 0.000, 353.7 mm ABM1/ABM2 = 44.8 dB ABM1 comp = 17.5 dB A/m BWC Factor = 0.0145801 dB Location: -6.6, 6.8, 363.7 mm	
Background Noise - 5mm Above Grid Reference/x (longitudinal) noise/ABM Noise(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm, Signal Type: Off, Output Gain: 100, Measure Window Start: 2000ms Measure Window Length: 5000ms, Device Reference Point: 0.000, 0.000, 353.7 mm ABM2 = -53.9 dB A/m Location: 0, 0, 368.7 mm	

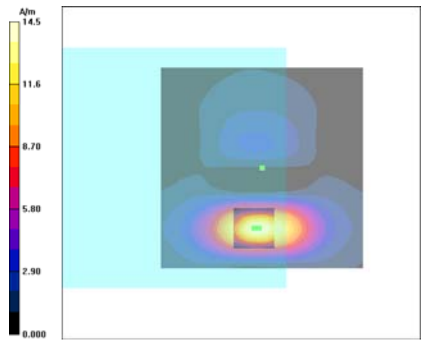
Longitudal Measurements, GSM1900	
Date/Time: 2010-09-10 09:16:17 Test Laboratory: TCC Nokia **Type: RM-717; Serial: 004402/13/169803/1** Communication System: T3 measurement Frequency: 1880 MHz; Medium: Air; Medium Notes: - Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3 Phantom section: AMB with Coil Section	DASY4 Configuration: - Probe: AM1DV3 - 3057 - ; Calibrated: 2009-10-28 - Sensor-Surface: 0mm (Fix Surface) - Electronics: DAE4 Sn1213; Calibrated: 2009-11-16 - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x - Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 184
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 Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav Output Gain: 72.7 Measure Window Start: 0ms Measure Window Length: 2000ms BWC applied: 10.8 dB Device Reference Point: 0.000, 0.000, 353.7 mm ABM1 = 13.0 dB A/m BWC Factor = 10.8 dB Location: -5, 4, 363.7 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 Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav Output Gain: 72.7 Measure Window Start: 0ms Measure Window Length: 2000ms BWC applied: 10.8 dB Device Reference Point: 0.000, 0.000, 353.7 mm ABM1 = 14.0 dB A/m BWC Factor = 10.8 dB Location: -7, 7, 363.7 mm
Point scan - Sinewave (Z-, X- and Y-scan @ MAX + Z-scan @ Acoustic Output)/x (longitudinal) scan at point with noise/ABM SNR(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm Signal Type: Audio File (.wav) 48k_1.025kHz_10s.wav Output Gain: 8.53 Measure Window Start: 0ms Measure Window Length: 10000ms BWC applied: 0.0184813 dB Device Reference Point: 0.000, 0.000, 353.7 mm ABM1/ABM2 = 47.3 dB ABM1 comp = 17.6 dB A/m BWC Factor = 0.0184813 dB Location: -6.6, 6.8, 363.7 mm	
Background Noise - 5mm Above Grid Reference/x (longitudinal) noise/ABM Noise(x,y,z) (1x1x1): Measurement grid: dx=10mm, dy=10mm, Signal Type: Off, Output Gain: 100, Measure Window Start: 2000ms Measure Window Length: 5000ms, Device Reference Point: 0.000, 0.000, 353.7 mm ABM2 = -53.9 dB A/m Location: 0, 0, 368.7 mm	

<table>
<tr><td colspan="2">Transversal Measurements, GSM850</td></tr>
<tr><td>Date/Time: 2010-09-09 13:32:12

Test Laboratory: TCC Nokia
Type: RM-717; Serial: 004402/13/169803/1
Communication System: T3 measurement
Frequency: 836.6 MHz; Duty Cycle: 1:999
Medium: Air; Medium Notes: -
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section</td>
<td>DASY4 Configuration:
- Probe: AM1DV3 - 3057
- ; Calibrated: 2009-10-28
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1213; Calibrated: 2009-11-16
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 184</td></tr>
<tr><td>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
Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav
Output Gain: 72.7
Measure Window Start: 0ms
Measure Window Length: 2000ms
BWC applied: 10.8 dB
Device Reference Point: 0.000, 0.000, 353.7 mm

ABM1 = 23.3 dB A/m
BWC Factor = 10.8 dB
Location: 2, 15, 363.7 mm</td>
<td>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
Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav
Output Gain: 72.7
Measure Window Start: 0ms
Measure Window Length: 2000ms
BWC applied: 10.8 dB
Device Reference Point: 0.000, 0.000, 353.7 mm

ABM1 = 23.8 dB A/m
BWC Factor = 10.8 dB
Location: 0.8, 15, 363.7 mm</td></tr>
<tr><td>Point scan - Sinewave (Z-, X- and Y-scan @ MAX + Z-scan @ Acoustic Output)/y (transversal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_1.025kHz_10s.wav
Output Gain: 8.53
Measure Window Start: 0ms
Measure Window Length: 10000ms
BWC applied: 0.0145801 dB
Device Reference Point: 0.000, 0.000, 353.7 mm

ABM1/ABM2 = 55.7 dB
ABM1 comp = 27.8 dB A/m
BWC Factor = 0.0145801 dB
Location: 0.8, 15, 363.7 mm</td>
<td>
</td></tr>
<tr><td colspan="2">Background Noise - 5mm Above Grid Reference/y (transversal) noise/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm, Signal Type: Off, Output Gain: 100, Measure Window Start: 2000ms
Measure Window Length: 5000ms, Device Reference Point: 0.000, 0.000, 353.7 mm

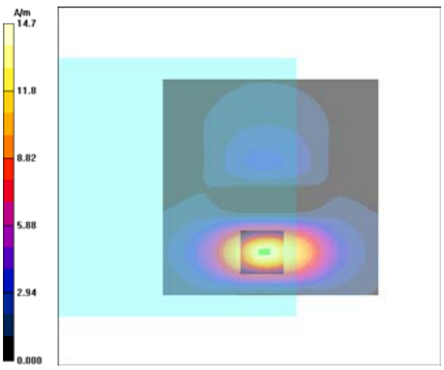
ABM2 = -54.2 dB A/m
Location: 0, 0, 368.7 mm</td></tr>
</table>

<table>
<tr><td colspan="2">Transversal Measurements, GSM1900</td></tr>
<tr><td>Date/Time: 2010-09-10 09:21:21

Test Laboratory: TCC Nokia
Type: RM-717; Serial: 004402/13/169803/1
Communication System: T3 measurement
Frequency: 1880 MHz; Duty Cycle: 1:999
Medium: Air; Medium Notes: -
Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m³
Phantom section: AMB with Coil Section</td><td>DASY4 Configuration:
- Probe: AM1DV3 - 3057
- ; Calibrated: 2009-10-28
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1213; Calibrated: 2009-11-16
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 184</td></tr>
<tr><td>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
Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav
Output Gain: 72.7
Measure Window Start: 0ms
Measure Window Length: 2000ms
BWC applied: 10.8 dB
Device Reference Point: 0.000, 0.000, 353.7 mm

ABM1 = 23.3 dB A/m
BWC Factor = 10.8 dB
Location: 2, 15, 363.7 mm</td><td>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
Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav
Output Gain: 72.7
Measure Window Start: 0ms
Measure Window Length: 2000ms
BWC applied: 10.8 dB
Device Reference Point: 0.000, 0.000, 353.7 mm

ABM1 = 24.1 dB A/m
BWC Factor = 10.8 dB
Location: 1, 14.8, 363.7 mm</td></tr>
<tr><td>Point scan - Sinewave (Z-, X- and Y-scan @ MAX + Z-scan @ Acoustic Output)/y (transversal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_1.025kHz_10s.wav
Output Gain: 8.53
Measure Window Start: 0ms
Measure Window Length: 10000ms
BWC applied: 0.0184813 dB
Device Reference Point: 0.000, 0.000, 353.7 mm

ABM1/ABM2 = 56.6 dB
ABM1 comp = 28.0 dB A/m
BWC Factor = 0.0184813 dB
Location: 0.8, 15, 363.7 mm</td><td></td></tr>
<tr><td colspan="2">Background Noise - 5mm Above Grid Reference/y (transversal) noise/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm, Signal Type: Off, Output Gain: 100, Measure Window Start: 2000ms
Measure Window Length: 5000ms, Device Reference Point: 0.000, 0.000, 353.7 mm

ABM2 = -54.2 dB A/m
Location: 0, 0, 368.7 mm</td></tr>
</table>

APPENDIX B: AUDIO MAGNETIC PROBE AM1DV3 **CALIBRATION DOCUMENT**

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

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

Accredited by the Swiss Accreditation Service (SAS)
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: AM1DV3-3057_Oct09

CALIBRATION CERTIFICATE

Object	AM1DV3 - SN: 3057
Calibration procedure(s)	QA CAL-24.v2 Calibration procedure for AM1D magnetic field probes and TMFS in the audio range
Calibration date:	October 28, 2009

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 (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	1-Oct-09 (No: 9055)	Oct-10
Reference Probe AM1DV3	SN: 3000	17-Aug-09 (No. AM1D-3000_Aug09)	Aug-10
DAE4	SN: 781	20-Feb-09 (No. DAE4-781_Feb09)	Feb-10

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
AMCC	1050	15-Oct-09 (in house check Oct-09)	Oct-10

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

Issued: October 28, 2009