

## HAC T-Coil Signal Test Report

|                                                  |                                                                                                                                                                                                                                                                                |                         |                                                                                                                                         |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Test report no.:                                 | Salo_HAC_0637_18                                                                                                                                                                                                                                                               | Date of report:         | 2006-Sep-19                                                                                                                             |
| Template version:                                | 1.0                                                                                                                                                                                                                                                                            | Number of pages:        | 24                                                                                                                                      |
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| Measurements made by:                            | Ari Orte                                                                                                                                                                                                                                                                       |                         |                                                                                                                                         |
| Tested devices:                                  | RM-198 (Hearing aid mode active), HW: 12010901                                                                                                                                                                                                                                 |                         |                                                                                                                                         |
| FCC ID:                                          | LJPRM-198H                                                                                                                                                                                                                                                                     | IC:                     | 661E-RM198                                                                                                                              |
| Supplement reports:                              | Salo_HAC_0637_17.pdf related HAC RF report                                                                                                                                                                                                                                     |                         |                                                                                                                                         |
| Testing has been carried out in accordance with: | <b>ANSI C63.19-2006</b><br>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:                                    | <b>The tested device complies with the requirements in respect of all parameters subject to the test.</b> 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:

2006-09-19

For the contents:



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Test System Manager

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## 1. SUMMARY OF HAC T-COIL SIGNAL TEST REPORT

### 1.1 Test Details

|                                             |                                                  |
|---------------------------------------------|--------------------------------------------------|
| Period of test                              | 2006-Sep-12 – 2006-Sep-13                        |
| SN, HW, SW and DUT numbers of tested device | SN: 004400/87/16796/9, HW: 12010901, SW: vp03.32 |
| Batteries used in testing                   | BL-5C, DUT: 10803, 10295                         |
| 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

| Mode     | Minimum limit<br>[dB (A/m)] | Result<br>[dB (A/m)] | Verdict |
|----------|-----------------------------|----------------------|---------|
| GSM 850  | -13                         | 9.2                  | Pass    |
| GSM 1900 | -13                         | 9.9                  | Pass    |

##### 1.2.1.2 Radial Field Intensity

| Mode     | Minimum limit<br>[dB (A/m)] | Minimum Result<br>[dB (A/m)] | Verdict |
|----------|-----------------------------|------------------------------|---------|
| GSM 850  | -18                         | 0.3                          | Pass    |
| GSM 1900 | -18                         | 1.1                          | Pass    |

#### 1.2.2 Frequency Response at Axial Measurement Point

| Mode     | Verdict |
|----------|---------|
| GSM 850  | Pass    |
| GSM 1900 | Pass    |

#### 1.2.3 Signal Quality

| Mode     | Minimum limit<br>[dB] |    |    |    | Minimum result<br>[dB] | Category |
|----------|-----------------------|----|----|----|------------------------|----------|
|          | T1                    | T2 | T3 | T4 |                        |          |
| GSM 850  | -15                   | -5 | 5  | 15 | 36.0                   | T4       |
| GSM 1900 | -15                   | -5 | 5  | 15 | 41.3                   | 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                                                                             |
| GSM 1900 | M3                                                                         | M3/T3                                                                             |

\*See separate report 'Salo\_HAC\_0637\_17.pdf'

### 1.3 Description of the Device Under Test (DUT)

| Modes and Bands of Operation      | GSM 850   | GSM 1900    |
|-----------------------------------|-----------|-------------|
| Modulation Mode                   | GMSK      | GMSK        |
| Duty Cycle                        | 1/8       | 1/8         |
| Transmitter Frequency Range (MHz) | 824...849 | 1850...1910 |

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

#### 1.3.1 Picture of Device

\*See separate report 'Salo\_HAC\_0637\_17\_setup photos.pdf'

## 2. TEST CONDITIONS

### 2.1 Temperature and Humidity

|                           |              |
|---------------------------|--------------|
| Ambient temperature (°C): | 20.0 to 22.0 |
| Ambient humidity (RH %):  | 40 to 60     |

### 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. EFR speech codec was used during testing.

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

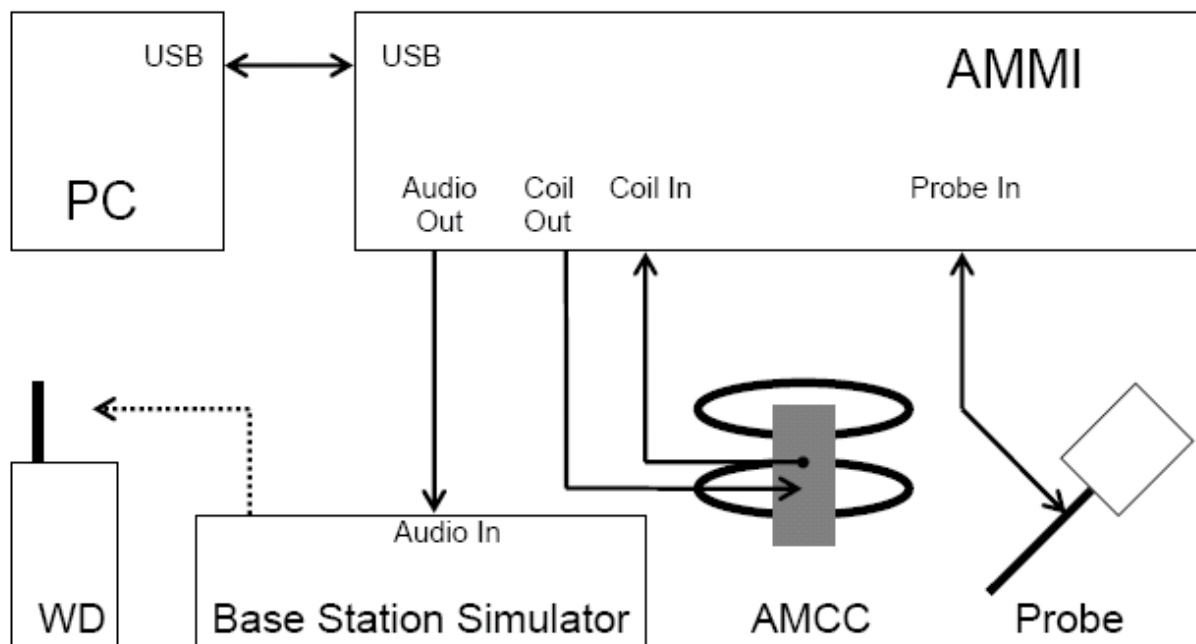
HAC mode was switched on from the WD user interface, volume setting was set to maximum and microphone was muted.

### 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                                         | 538           | 12 months            | 05/07              |
| AMMI Audio Magnetic Measurement Instrument     | 1002          | 12 months            | 02/07              |
| AM1DV3 Audio Magnetic Probe                    | 3036          | 12 months            | 08/07              |
| AMCC Helmholtz Audio Magnetic Calibration Coil | 1004          | 12 months            | 02/07              |
| R&S CMU200 Radio Communication Test Set        | 104983        | -                    | -                  |

#### 3.1.1 Audio Magnetic Probe AM1DV3

|                     |                                                                |
|---------------------|----------------------------------------------------------------|
| <b>Construction</b> | Fully RF shielded metal construction (RF sensitivity < -100dB) |
| <b>Calibration</b>  | Calibrated using Helmholtz coil                                |
| <b>Frequency</b>    | 0.1 – 20 kHz                                                   |
| <b>Sensitivity</b>  | < -50 dB A/m                                                   |
| <b>Dimensions</b>   | Overall length: 290 mm; Tip diameter: 6 mm                     |

#### 3.1.2 Audio Magnetic Measurement Instrument AMMI

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

#### 3.1.3 Audio Magnetic Calibration Coil AMCC

|                   |                                             |
|-------------------|---------------------------------------------|
| <b>Dimensions</b> | 370 x 370 x 196 mm (ANSI-PC63.19 compliant) |
|-------------------|---------------------------------------------|

#### 3.1.4 WD positioner

The WD positioner 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 positioner 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 positioned under Test Arch.



Device holder and Test Arch supplied by SPEAG

### 4.2 Test Positions

The device was positioned such that Device Reference level was touching the bottom of the Test Arch. The speaker 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 speaker 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 signals are 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 @ 1 kHz.

## 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

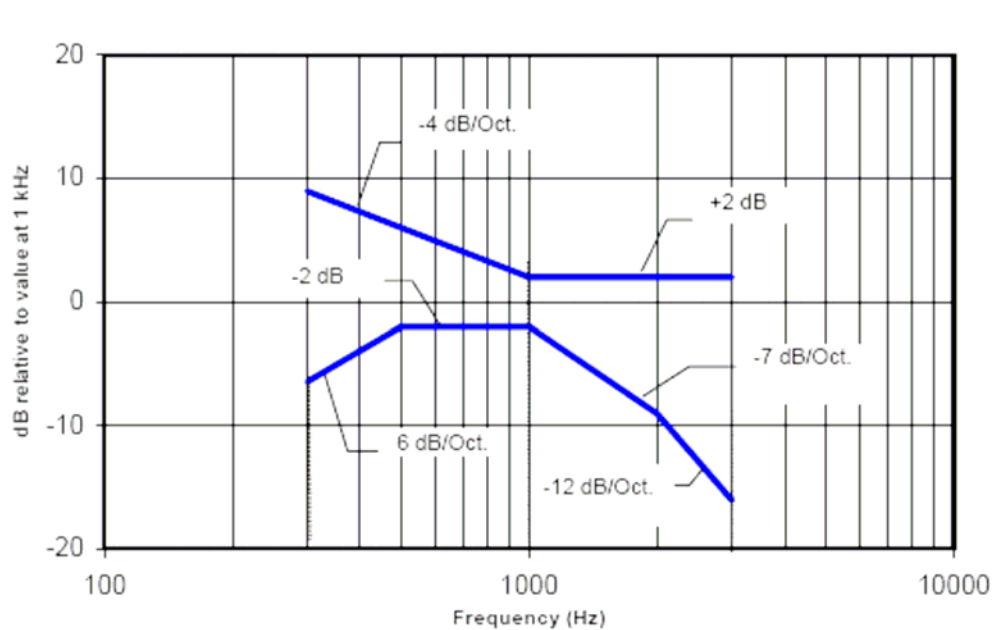
The axial component of the magnetic field shall be  $\geq -13\text{dB(A/m)}$  at 1 kHz, in 1/3 octave band filter.

### Radial Field Intensity

The radial components of the magnetic field shall be  $\geq -18\text{dB(A/m)}$  at 1 kHz, in 1/3 octave band filter.

## Frequency Response

Frequency response of the axial component must follow the frequency curve depicted 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

Measurement uncertainty budget presented in Appendix B.

## 6. RESULTS

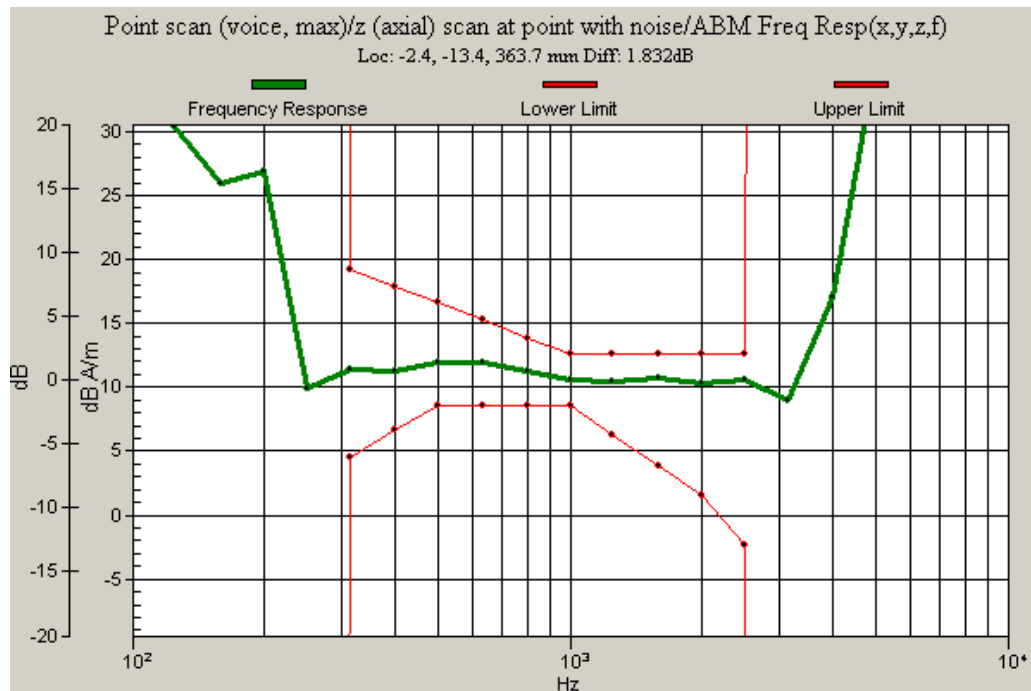
Measurement position coordinates are defined as deviation from earpiece center in millimeters. Coordinate system is defined in chapter 4.2

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.

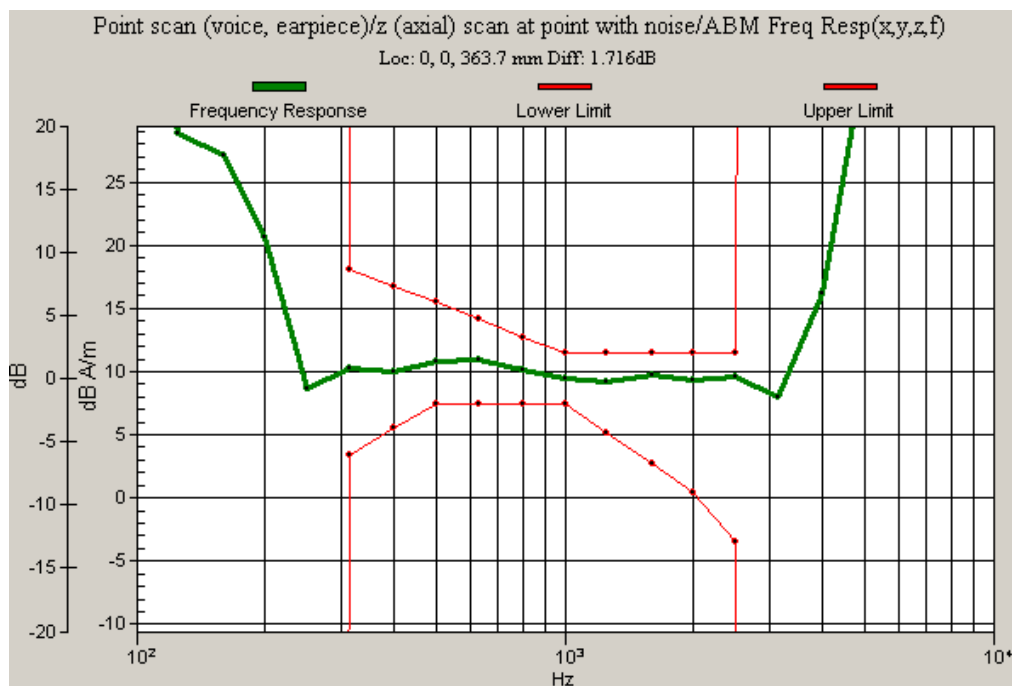
|                                                      | Radial 1<br>(longitudinal) |       | Radial 2<br>(transversal) |         | Axial      |       |            |       |
|------------------------------------------------------|----------------------------|-------|---------------------------|---------|------------|-------|------------|-------|
| Mode                                                 | 850                        | 1900  | 850                       | 1900    | 850        |       | 1900       |       |
| Measurement position (x,y) [mm]                      | 6,-15                      | 6,-15 | -1.6,-5                   | -1.6,-5 | -2.4,-13.4 | 0, 0  | -2.4,-13.4 | 0, 0  |
| Signal strength [dB A/m]                             | 0.3                        | 1.1   | 10.6                      | 11.1    | 11.1       | 9.2   | 11.8       | 9.9   |
| ABM2 [dB A/m]                                        | -35.6                      | -40.2 | -45.3                     | -43.6   | -44.9      | -44.3 | -42.9      | -43.8 |
| Signal quality [dB]                                  | 36.0                       | 41.3  | 55.9                      | 54.7    | 55.9       | 53.5  | 54.7       | 53.8  |
| Ambient background noise at point (0,0) ABM [dB A/m] | -53.9                      | -53.6 | -53.9                     | -54.0   | -52.0      | -52.0 | -50.8      | -50.8 |

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

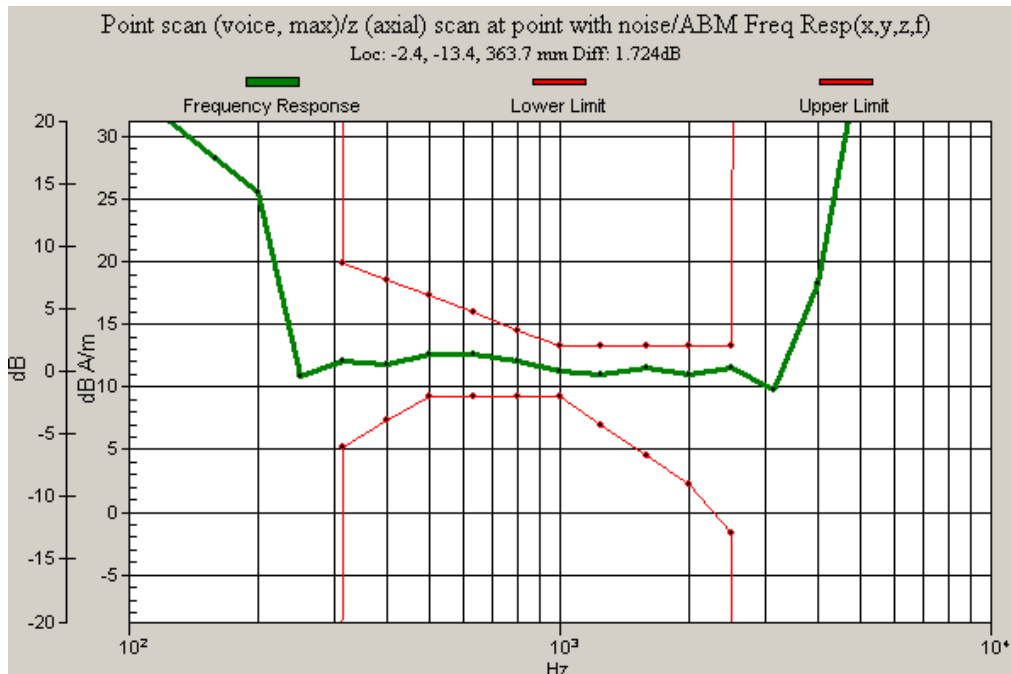
The curves illustrating frequency response for GSM850 and GSM1900 modes:



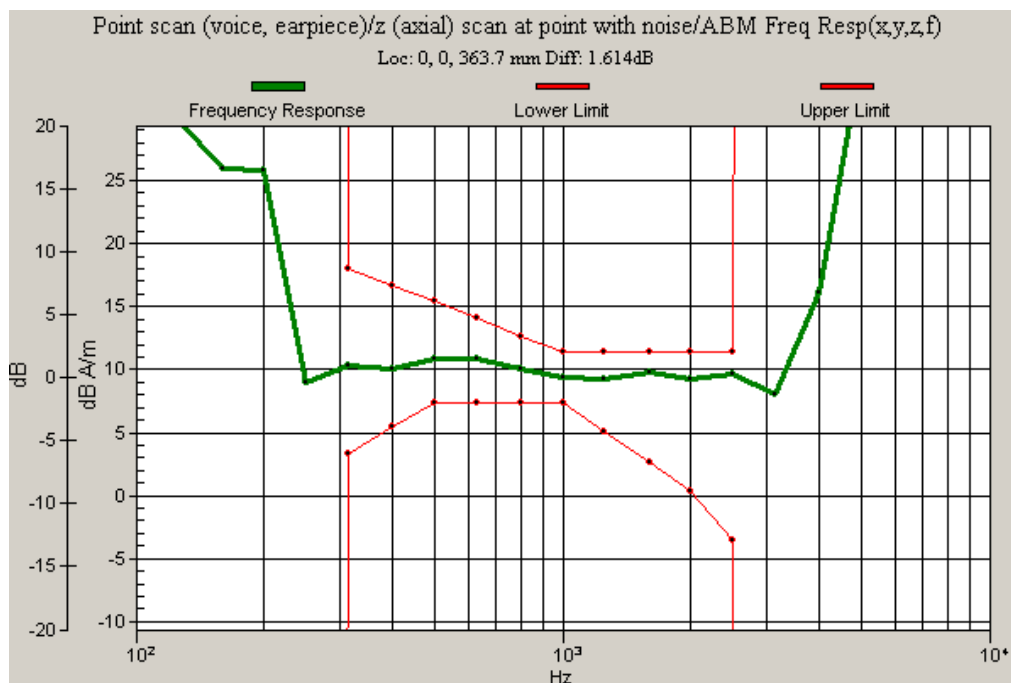
Frequency response in GSM850 mode, the point of maximum signal strength (axial)



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

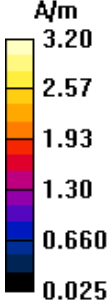
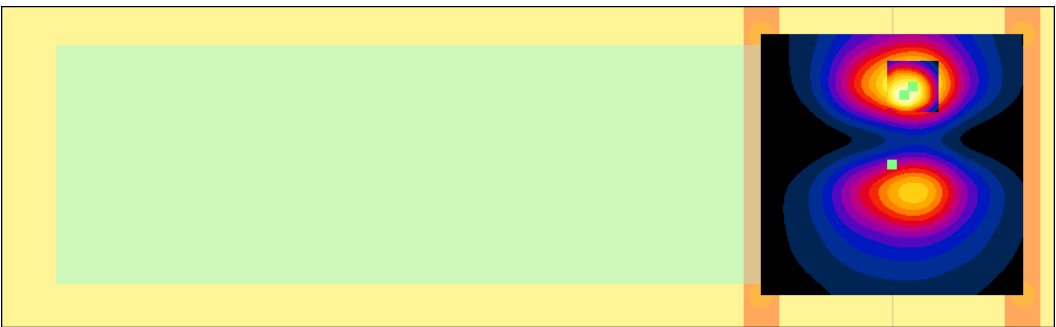


Frequency response in GSM1900 mode, the point of maximum signal strength (axial)

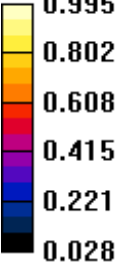
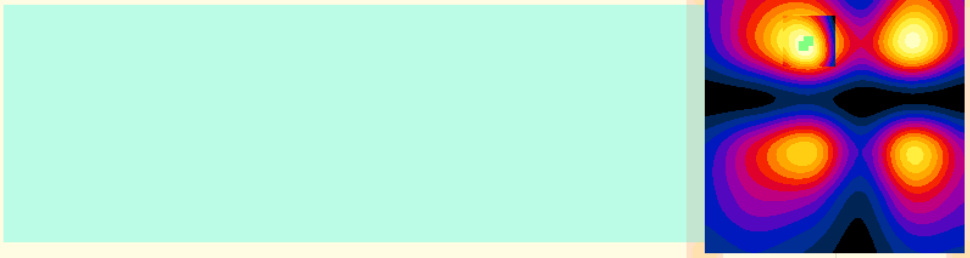


Frequency response in GSM1900 mode, point 0,0 (axial)

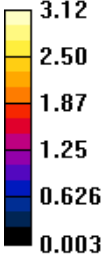
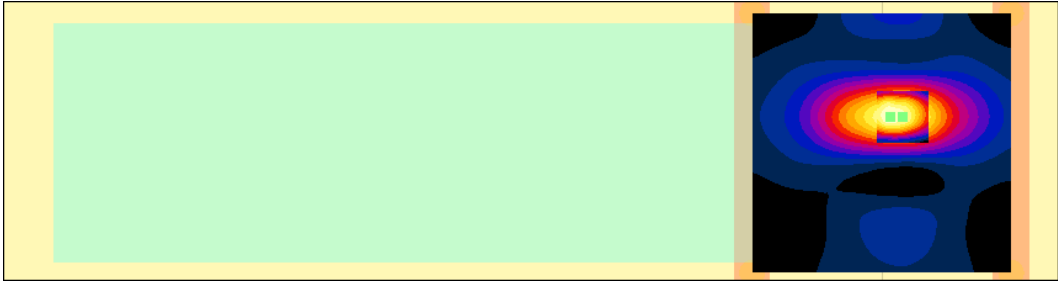
## **APPENDIX A: MEASUREMENT SCANS**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Date/Time: 2006-09-13 14:56:41</b><br/> Test Laboratory: TCC Nokia, Salo Laboratory<br/> <b>Type: RM-198</b>; Serial: 004400/87/16796/9<br/> <b>Communication System: GSM850</b><br/> Frequency: 836.6 MHz; Duty Cycle: 1:7<br/> Medium: Air; Medium Notes: Not Specified<br/> Medium parameters used: <math>\sigma = 0</math> mho/m, <math>\epsilon_r = 1</math>; <math>\rho = 1</math> kg/m<sup>3</sup><br/> Phantom section: AMB with Coil Section</p>                                                                                                                                                                                                                                                                                  | <p><b>DASY4 Configuration:</b><br/> - Probe: AM1DV3 - 3036; Probe Notes: SP AM1 001 BA<br/> - ; Calibrated: 2006-08-03<br/> - Sensor-Surface: 0mm (Fix Surface)<br/> - Electronics: DAE4 Sn538; Calibrated: 2006-05-17<br/> - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1004<br/> - Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171</p>                                                                                                                                                                                                                                                                                                                                               |
| <p><b>Coarse scan/z (axial) scan 50 x 50 (grid 10) with noise/ABM Interpolated Signal(x,y,z) (51x51x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1 = 10.0933 dB A/m<br/> BWC Factor = 10.8 dB<br/> Location: -4, -15, 363.7 mm</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p><b>Fine scan/z (axial) scan 10 x 10 (grid 2) with noise/ABM Interpolated Signal(x,y,z) (51x51x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1 = 10.5997 dB A/m<br/> BWC Factor = 10.8 dB<br/> Location: -2.4, -13.4, 363.7 mm</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p><b>Point scan (sinewave, max)/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1 comp = 11.0739 dB A/m<br/> BWC Factor = -0.209998 dB<br/> Location: -2.4, -13.4, 363.7 mm<br/> <b>Point scan (sinewave, max)/z (axial) scan at point with noise/ABM Noise(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM2 = -44.8672 dB A/m<br/> Location: -2.4, -13.4, 363.7 mm<br/> <b>Point scan (sinewave, max)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1/ABM2 = 55.9411 dB<br/> BWC Factor = -0.209998 dB<br/> Location: -2.4, -13.4, 363.7 mm</p> | <p><b>Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1 comp = 9.19384 dB A/m<br/> BWC Factor = -0.206004 dB<br/> Location: 0, 0, 363.7 mm<br/> <b>Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM Noise(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM2 = -44.3169 dB A/m<br/> Location: 0, 0, 363.7 mm<br/> <b>Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1/ABM2 = 53.5107 dB<br/> BWC Factor = -0.206004 dB<br/> Location: 0, 0, 363.7 mm</p> |
| <p><b>A/m</b></p>  <p>3.20<br/>2.57<br/>1.93<br/>1.30<br/>0.660<br/>0.025</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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| <p><b>Date/Time:</b> 2006-09-13 19:32:43<br/>Test Laboratory: TCC Nokia, Salo Laboratory</p> <p><b>Type:</b> RM-198; Serial: 004400/87/16796/9<br/><b>Communication System:</b> DCS 1900<br/>Frequency: 1880 MHz; Duty Cycle: 1:8.3<br/>Medium: Air; Medium Notes: Not Specified<br/>Medium parameters used: <math>\sigma = 0</math> mho/m, <math>\epsilon_r = 1</math>; <math>\rho = 1</math> kg/m<sup>3</sup><br/>Phantom section: AMB with Coil Section</p>                                                                                                                                                                                                                                                                        | <p><b>DASY4 Configuration:</b><br/>- Probe: AM1DV3 - 3036; Probe Notes: SP AM1 001 BA<br/>- ; Calibrated: 2006-08-03<br/>- Sensor-Surface: 0mm (Fix Surface)<br/>- Electronics: DAE4 Sn538; Calibrated: 2006-05-17<br/>- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1004<br/>- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171</p>                                                                                                                                                                                                                                                                                                                                           |
| <p><b>Point scan (sinewave, max)/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1):</b><br/>Measurement grid: dx=10mm, dy=10mm<br/>Cursor:<br/>ABM1 comp = 11.7614 dB A/m<br/>BWC Factor = -0.202998 dB<br/>Location: -2.4, -13.4, 363.7 mm</p> <p><b>Point scan (sinewave, max)/z (axial) scan at point with noise/ABM Noise(x,y,z) (1x1x1):</b><br/>Measurement grid: dx=10mm, dy=10mm<br/>Cursor:<br/>ABM2 = -42.903 dB A/m<br/>Location: -2.4, -13.4, 363.7 mm</p> <p><b>Point scan (sinewave, max)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):</b><br/>Measurement grid: dx=10mm, dy=10mm<br/>Cursor:<br/>ABM1/ABM2 = 54.6644 dB<br/>BWC Factor = -0.202998 dB<br/>Location: -2.4, -13.4, 363.7 mm</p> | <p><b>Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1):</b><br/>Measurement grid: dx=10mm, dy=10mm<br/>Cursor:<br/>ABM1 comp = 9.91006 dB A/m<br/>BWC Factor = -0.211004 dB<br/>Location: 0, 0, 363.7 mm</p> <p><b>Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM Noise(x,y,z) (1x1x1):</b><br/>Measurement grid: dx=10mm, dy=10mm<br/>Cursor:<br/>ABM2 = -43.8463 dB A/m<br/>Location: 0, 0, 363.7 mm</p> <p><b>Point scan (sinewave, earpiece)/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):</b><br/>Measurement grid: dx=10mm, dy=10mm<br/>Cursor:<br/>ABM1/ABM2 = 53.7564 dB<br/>BWC Factor = -0.211004 dB<br/>Location: 0, 0, 363.7 mm</p> |

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| <p><b>Date/Time:</b> 2006-09-13 14:40:50<br/> <b>Test Laboratory:</b> TCC Nokia, Salo Laboratory</p> <p><b>Type:</b> RM-198; Serial: 004400/87/16796/9<br/> <b>Communication System:</b> GSM850<br/> Frequency: 836.6 MHz; Duty Cycle: 1:7<br/> Medium: Air; Medium Notes: Not Specified<br/> Medium parameters used: <math>\sigma = 0</math> mho/m, <math>\epsilon_r = 1</math>; <math>\rho = 1</math> kg/m<sup>3</sup><br/> Phantom section: AMB with Coil Section</p>                                                                                                                                                                                                                                                                                    | <p><b>DASY4 Configuration:</b><br/> - Probe: AM1DV3 - 3036; Probe Notes: SP AM1 001 BA<br/> - ; Calibrated: 2006-08-03<br/> - Sensor-Surface: 0mm (Fix Surface)<br/> - Electronics: DAE4 Sn538; Calibrated: 2006-05-17<br/> - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1004<br/> - Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171</p> |
| <p><b>Coarse scan/x (longitudinal) scan 50 x 50 (grid 10) with noise/ABM Interpolated Signal(x,y,z) (51x51x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1 = -0.0408128 dB A/m<br/> BWC Factor = 10.8 dB<br/> Location: 5, -16, 363.7 mm</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                              |
| <p><b>Fine scan/x (longitudinal) scan 10 x 10 (grid 2) with noise/ABM Interpolated Signal(x,y,z) (51x51x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1 = -0.0596369 dB A/m<br/> BWC Factor = 10.8 dB<br/> Location: 6, -15, 363.7 mm</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                              |
| <p><b>Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM Signal(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1 comp = 0.349794 dB A/m<br/> BWC Factor = -0.209998 dB<br/> Location: 6, -15, 363.7 mm</p> <p><b>Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM Noise(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM2 = -35.6423 dB A/m<br/> Location: 6, -15, 363.7 mm</p> <p><b>Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1/ABM2 = 35.9921 dB<br/> BWC Factor = -0.209998 dB<br/> Location: 6, -15, 363.7 mm</p> |                                                                                                                                                                                                                                                                                                                                                                                              |
| <p><b>A/m</b></p>  <p>0.995<br/>0.802<br/>0.608<br/>0.415<br/>0.221<br/>0.028</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                          |

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| <b>Date/Time: 2006-09-13 19:32:43</b><br>Test Laboratory: TCC Nokia, Salo Laboratory<br><br><b>Type: RM-198;</b> Serial: 004400/87/16796/9<br><b>Communication System: DCS 1900</b><br>Frequency: 1880 MHz; Duty Cycle: 1:8.3<br>Medium: Air; Medium Notes: Not Specified<br>Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$ ; $\rho = 1$ kg/m <sup>3</sup><br>Phantom section: AMB with Coil Section                                                                                                                                                                                                                                                                                                      | <b>DASY4 Configuration:</b><br>- Probe: AM1DV3 - 3036; Probe Notes: SP AM1 001 BA<br>- ; Calibrated: 2006-08-03<br>- Sensor-Surface: 0mm (Fix Surface)<br>- Electronics: DAE4 Sn538; Calibrated: 2006-05-17<br>- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1004<br>- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171 |
| <b>Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM Signal(x,y,z) (1x1x1):</b><br>Measurement grid: dx=10mm, dy=10mm<br>Cursor:<br>ABM1 comp = 1.14021 dB A/m<br>BWC Factor = -0.202998 dB<br>Location: 6, -15, 363.7 mm<br><br><b>Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM Noise(x,y,z) (1x1x1):</b><br>Measurement grid: dx=10mm, dy=10mm<br>Cursor:<br>ABM2 = -40.1931 dB A/m<br>Location: 6, -15, 363.7 mm<br><br><b>Point scan (sinewave, max)/x (longitudinal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):</b><br>Measurement grid: dx=10mm, dy=10mm<br>Cursor:<br>ABM1/ABM2 = 41.3333 dB<br>BWC Factor = -0.202998 dB<br>Location: 6, -15, 363.7 mm |                                                                                                                                                                                                                                                                                                                                                                           |

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| <p><b>Date/Time: 2006-09-13 14:45:37</b><br/> Test Laboratory: TCC Nokia, Salo Laboratory</p> <p><b>Type: RM-198;</b> Serial: 004400/87/16796/9<br/> <b>Communication System: GSM850</b><br/> Frequency: 836.6 MHz; Duty Cycle: 1:7<br/> Medium: Air; Medium Notes: Not Specified<br/> Medium parameters used: <math>\sigma = 0</math> mho/m, <math>\epsilon_r = 1</math>; <math>\rho = 1</math> kg/m<sup>3</sup><br/> Phantom section: AMB with Coil Section</p> | <p><b>DASY4 Configuration:</b><br/> - Probe: AM1DV3 - 3036; Probe Notes: SP AM1 001 BA<br/> - ; Calibrated: 2006-08-03<br/> - Sensor-Surface: 0mm (Fix Surface)<br/> - Electronics: DAE4 Sn538; Calibrated: 2006-05-17<br/> - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1004<br/> - Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171</p> |
| <p><b>Coarse scan/y (transversal) scan 50 x 50 (grid 10) with noise/ABM Interpolated Signal(x,y,z) (51x51x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1 = 9.89646 dB A/m<br/> BWC Factor = 10.8 dB<br/> Location: -4, -5, 363.7 mm</p>                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                              |
| <p><b>Fine scan/y (transversal) scan 10 x 10 (grid 2) with noise/ABM Interpolated Signal(x,y,z) (51x51x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1 = 10.138 dB A/m<br/> BWC Factor = 10.8 dB<br/> Location: -1.6, -5, 363.7 mm</p>                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                              |
| <p><b>Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM Signal(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1 comp = 10.5541 dB A/m<br/> BWC Factor = -0.209998 dB<br/> Location: -1.6, -5, 363.7 mm</p>                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                              |
| <p><b>Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM Noise(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM2 = -45.326 dB A/m<br/> Location: -1.6, -5, 363.7 mm</p>                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                              |
| <p><b>Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1/ABM2 = 55.8801 dB<br/> BWC Factor = -0.209998 dB<br/> Location: -1.6, -5, 363.7 mm</p>                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                              |
| <p><b>A/m</b></p>  <p>3.12<br/>2.50<br/>1.87<br/>1.25<br/>0.626<br/>0.003</p>                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                          |

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| <p><b>Date/Time: 2006-09-13 19:32:43</b><br/> Test Laboratory: TCC Nokia, Salo Laboratory</p> <p><b>Type: RM-198;</b> Serial: 004400/87/16796/9<br/> <b>Communication System: DCS 1900</b><br/> Frequency: 1880 MHz; Duty Cycle: 1:8.3<br/> Medium: Air; Medium Notes: Not Specified<br/> Medium parameters used: <math>\sigma = 0</math> mho/m, <math>\epsilon_r = 1</math>; <math>\rho = 1</math> kg/m<sup>3</sup><br/> Phantom section: AMB with Coil Section</p>                                                                                                                                                                                                                                                                                          | <p><b>DASY4 Configuration:</b><br/> - Probe: AM1DV3 - 3036; Probe Notes: SP AM1 001 BA<br/> - ; Calibrated: 2006-08-03<br/> - Sensor-Surface: 0mm (Fix Surface)<br/> - Electronics: DAE4 Sn538; Calibrated: 2006-05-17<br/> - Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1004<br/> - Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171</p> |
| <p><b>Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM Signal(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1 comp = 11.1036 dB A/m<br/> BWC Factor = -0.202998 dB<br/> Location: -1.6, -5, 363.7 mm</p> <p><b>Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM Noise(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM2 = -43.6343 dB A/m<br/> Location: -1.6, -5, 363.7 mm</p> <p><b>Point scan (sinewave, max)/y (transversal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):</b><br/> Measurement grid: dx=10mm, dy=10mm<br/> Cursor:<br/> ABM1/ABM2 = 54.7378 dB<br/> BWC Factor = -0.202998 dB<br/> Location: -1.6, -5, 363.7 mm</p> |                                                                                                                                                                                                                                                                                                                                                                                              |

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| <b>Date/Time: 2006-09-13 14:45:37</b><br>Test Laboratory: TCC Nokia, Salo Laboratory<br><b>Type: RM-198</b> ; Serial: 004400/87/16796/9<br><b>Communication System: GSM850</b><br>Frequency: 836.6 MHz; Duty Cycle: 1:7<br>Medium: Air; Medium Notes: Not Specified<br>Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$ ; $\rho = 1$ kg/m <sup>3</sup><br>Phantom section: AMB with Coil Section |                                                                                                                                                                                                        |                                                                                                                                                                                                         | <b>DASY4 Configuration:</b><br>- Probe: AM1DV3 - 3036; Probe Notes: SP AM1 001 BA<br>- ; Calibrated: 2006-08-03<br>- Sensor-Surface: 0mm (Fix Surface)<br>- Electronics: DAE4 Sn538; Calibrated: 2006-05-17<br>- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1004<br>- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171 |
| <b>Background noise 5mm above Grid Reference/z (axial) noise/ABM Noise(x,y,z) (1x1x1):</b><br>Measurement grid: dx=10mm, dy=10mm<br>Cursor:<br>ABM2 = -51.9907 dB A/m<br>Location: 0, 0, 368.7 mm                                                                                                                                                                                                            | <b>Background noise 5mm above Grid Reference/x (longitudinal) noise/ABM Noise(x,y,z) (1x1x1):</b><br>Measurement grid: dx=10mm, dy=10mm<br>Cursor:<br>ABM2 = -53.87 dB A/m<br>Location: 0, 0, 368.7 mm | <b>Background noise 5mm above Grid Reference/y (transversal) noise/ABM Noise(x,y,z) (1x1x1):</b><br>Measurement grid: dx=10mm, dy=10mm<br>Cursor:<br>ABM2 = -53.8646 dB A/m<br>Location: 0, 0, 368.7 mm |                                                                                                                                                                                                                                                                                                                                                                           |

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| <b>Date/Time: 2006-09-13 16:57:38</b><br>Test Laboratory: TCC Nokia, Salo Laboratory<br><b>Type: RM-198</b> ; Serial: 004400/87/16796/9<br><b>Communication System: DCS 1900</b><br>Frequency: 1880 MHz; Duty Cycle: 1:8.3<br>Medium: Air; Medium Notes: Not Specified<br>Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$ ; $\rho = 1$ kg/m <sup>3</sup><br>Phantom section: AMB with Coil Section |                                                                                                                                                                                                          |                                                                                                                                                                                                         | <b>DASY4 Configuration:</b><br>- Probe: AM1DV3 - 3036; Probe Notes: SP AM1 001 BA<br>- ; Calibrated: 2006-08-03<br>- Sensor-Surface: 0mm (Fix Surface)<br>- Electronics: DAE4 Sn538; Calibrated: 2006-05-17<br>- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1004<br>- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171 |
| <b>Background noise 5mm above Grid Reference/z (axial) noise/ABM Noise(x,y,z) (1x1x1):</b><br>Measurement grid: dx=10mm, dy=10mm<br>Cursor:<br>ABM2 = -50.8092 dB A/m<br>Location: 0, 0, 368.7 mm                                                                                                                                                                                                               | <b>Background noise 5mm above Grid Reference/x (longitudinal) noise/ABM Noise(x,y,z) (1x1x1):</b><br>Measurement grid: dx=10mm, dy=10mm<br>Cursor:<br>ABM2 = -53.6088 dB A/m<br>Location: 0, 0, 368.7 mm | <b>Background noise 5mm above Grid Reference/y (transversal) noise/ABM Noise(x,y,z) (1x1x1):</b><br>Measurement grid: dx=10mm, dy=10mm<br>Cursor:<br>ABM2 = -53.9641 dB A/m<br>Location: 0, 0, 368.7 mm |                                                                                                                                                                                                                                                                                                                                                                           |

## **APPENDIX B: MEASUREMENT UNCERTAINTY**

Measurement uncertainty budget is currently under evaluation.

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**APPENDIX C: AUDIO MAGNETIC PROBE AM1D CALIBRATION DOCUMENT**

Client 

## Certificate of test and configuration

|                       |                                                        |
|-----------------------|--------------------------------------------------------|
| Item                  | Audio Magnetic 1D Field Probe<br><b>AM1DV3</b>         |
| Type No               | SP AM1 001 BA                                          |
| Series No             | <b>3036</b>                                            |
| Manufacturer / Origin | Schmid & Partner Engineering AG<br>Zurich, Switzerland |

### Description of the item

The Audio Magnetic Field Probe is a fully shielded magnetic field probe for the frequency range from 100 Hz to 20 kHz. The pickup coil is compliant with the dimensional requirements of [1]. The probe includes a symmetric 20dB low noise amplifier for the signal available at the shielded 3 pin connector at the side. Power is supplied via the same connector (phantom power supply) and monitored via the LED near the connector. The 7 pin connector at the end of the probe does not carry any signals, but determines the angle of the sensor when mounted on the DAE. The probe supports mechanical detection of the surface. The single sensor in the probe is arranged in a tilt angle allowing measurement of 3 orthogonal field components when rotating the probe by 120° around its axis. It is aligned with the perpendicular component of the field, if the probe axis is tilted 35.3° above the measurement plane, using the connector rotation and Sensor angle stated below.

The probe is fully RF shielded when operated with the matching signal cable (shielded) and allows measurement of audio magnetic fields in the close vicinity of RF emitting wireless devices according to [1] without additional shielding.

### Handling of the item

The probe is manufactured from stainless steel. In order to maintain the performance and calibration of the probe, it must not be opened. The probe is designed for operation in air and shall not be exposed to humidity or liquids. For proper operation of the surface detection and emergency stop functions in the DASY4 system, the probe must be operated with the special probe cup provided (larger diameter).

### Functional test

The probe configuration data were evaluated after a functional test including amplification, dynamic range and RF immunity.

### DASY4 configuration data for the probe

| Configuration item | Condition                                                                                    | Configuration Data | Dimension |
|--------------------|----------------------------------------------------------------------------------------------|--------------------|-----------|
| Overall length     | mounted on DAE in DASY4 system                                                               | <b>296</b>         | mm        |
| Tip diameter       | at the cylindrical part                                                                      | 6                  | mm        |
| Sensor offset      | center of sensor, from tip                                                                   | 3                  | mm        |
| Connector rotation | Evaluated in homogeneous 1 kHz magnetic field generated with AMCC Helmholtz Calibration Coil | <b>-7.0</b>        | °         |
| Sensor angle       |                                                                                              | <b>0.34</b>        | °         |
| Sensitivity        | typical, at 1 kHz                                                                            | 0.0068             | V / (A/m) |

### Standards

[1] ANSI-C63.19-2006

Date 03.08.2006

Signature 