HAC T-Coil TEST REPORT

No. 2013EEB00057-2

For

Emporia Telecom USA Inc

GSM Dual Band Mobile Phone

Model name: VF4

Marketing Name :RL2

With

Hardware Version: VF4__MB_V2.0

Software Version: VF4_USA_NW_TFT_130218

FCC ID: ZVP-RL2

Results Summary: T Category = T3

Issued Date: 2013-03-08

Note:

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of TMC Beijing.

Test Laboratory:

TMC Beijing, Telecommunication Metrology Center of MIIT

No. 52, Huayuan Bei Road, Haidian District, Beijing, P. R. China 100191.

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TABLE OF CONTENT

1 Test Laboratory

1.1 Testing Location

Company Name:	TMC Shenzhen, Telecommunication Metrology Center of MIIT
Address:	No. 12building, Shangsha Innovation and Technology Park, Futian District, Shenzhen, P. R. China
Postal Code:	518048
Telephone:	+86-755-33322000
Fax:	+86-755-33322001

1.2 Testing Environment

Temperature:	18°C~25 °C,
Relative humidity:	30%~ 70%
Ground system resistance:	< 0.5 Ω

Ambient noise is checked and found very low and in compliance with requirement of standards.
Reflection of surrounding objects is minimized and in compliance with requirement of standards.

1.3 Project Data

Project Leader:	Zhou Yi
Test Engineer:	Zhu Zhiqiang
Testing Start Date:	Mar 04th, 2013
Testing End Date:	Mar 04th, 2013

1.4 Signature

Zhu Zhiqiang
(Prepared this test report)

Zhou Yi
(Reviewed this test report)

Lu Minniu
Director of the laboratory
(Approved this test report)

2 Client Information

2.1 Applicant Information

Company Name:	Emporia Telecom USA Inc
Address /Post:	321 E. Glen Ave, Ridgewood
City:	New Jersey
Postal Code:	/
Contact Person	Silva Hoo
Email	foley@emporiatelecom.com
Country:	USA
Telephone:	201-962-5550
Fax:	/

2.2 Manufacturer Information

Company Name:	Emporia Telecom USA Inc
Address /Post:	321 E. Glen Ave, Ridgewood
City:	New Jersey
Postal Code:	/
Contact Person	Silva Hoo
Email	foley@emporiatelecom.com
Country:	USA
Telephone:	201-962-5550
Fax:	/

3 Equipment Under Test (EUT) and Ancillary Equipment (AE)

3.1 About EUT

Description:	GSM quad band mobile phone
Model name:	VF4
Marketing name:	RL2
Operating mode(s):	GSM 850/1900
Tested Tx Frequency:	825 – 848.8 MHz (GSM 850)
	1850.2 – 1910 MHz (GSM 1900)
Test Modulation	(GSM)GMSK;
Power class:	GSM850: tested with power level 5
	GSM1900: tested with power level 0
Test device Production information:	Production unit
Device type:	Portable device
Antenna type:	Integrated antenna

Figure 3.1 Constituents of the sample (Lithium Battery is in the Handset)

3.2 Internal Identification of EUT used during the test

EUT ID*	SN or IMEI	HW Version	SW Version
EUT1	353060025208913	VF4__MB_V2.0	VF4_USA_NW_TFT_130218

*EUT ID: is used to identify the test sample in the lab internally.

3.3 Internal Identification of AE used during the test

AE ID*	Description	Model	SN	Manufacturer
AE1	Battery	AK-RL2	/	Shenzhen Renergy Technology Co. Ltd

4 CONDUCTED OUTPUT POWER MEASUREMENT

4.1 Summary

During the process of testing, the EUT was controlled via Rhode & Schwarz Digital Radio Communication tester (CMU-200) to ensure the maximum power transmission and proper modulation. This result contains conducted output power and ERP for the EUT. In all cases, the measured peak output power should be greater and within 5% than EMI measurement.

4.2 Conducted Power

GSM 850MHz	**Conducted Power (dBm)**		
	Channel 251(848.8MHz)	**Channel 190(836.6MHz)**	**Channel 128(824.2MHz)**
	32.81	32.28	32.77
GSM 1900MHz	**Conducted Power (dBm)**		
	Channel 810(1909.8MHz)	**Channel 661(1880MHz)**	**Channel 512(1850.2MHz)**
	29.45	30.01	30.33

5. Reference Documents

5.1Reference Documents for testing

The following document listed in this section is referred for testing.

Reference	**Title**	**Version**
ANSI C63.19-2007	American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids	2007 Edition

6 OPERATIONAL CONDITIONS DURING TEST

6.1 HAC MEASUREMENT SET-UP

These measurements are performed using the DASY5 NEO automated dosimetric assessment system. It is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland. It consists of high precision robotics system (Stäubli), robot controller, Intel Core2 computer, near-field probe, probe alignment sensor. The robot is a six-axis industrial robot performing precise movements. A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The PC consists of the HP Intel Core2 1.86 GHz computer with Windows XP system and HAC Measurement Software DASY5 NEO, A/D interface card, monitor, mouse, and keyboard. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

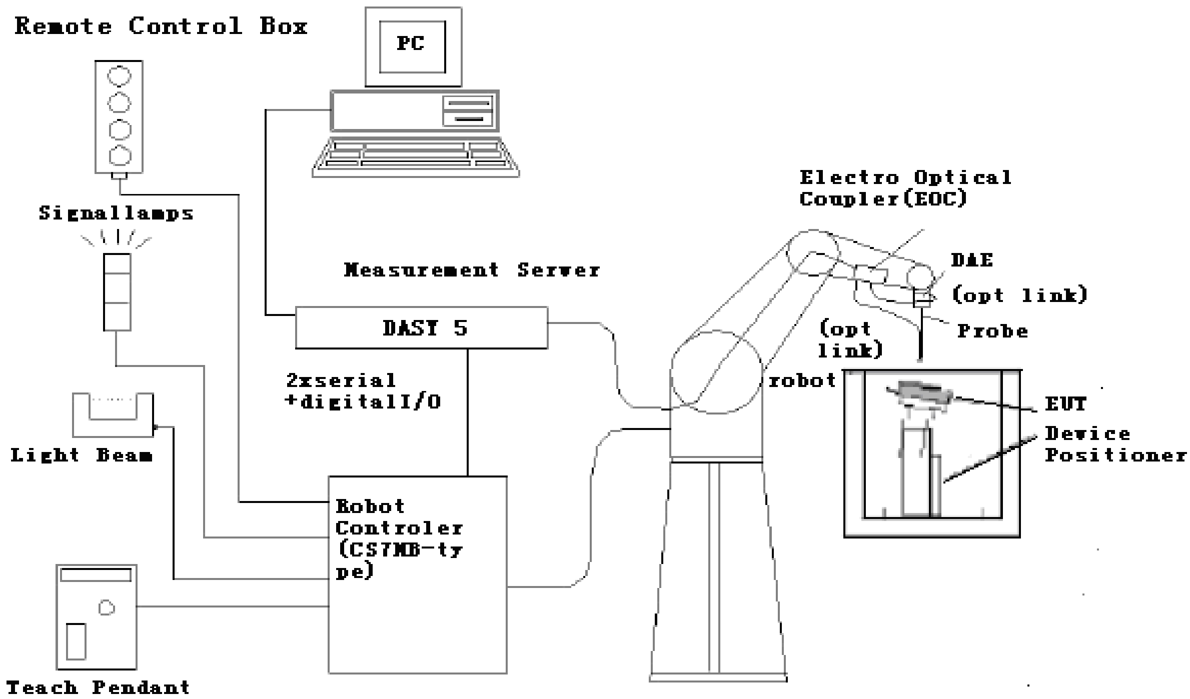
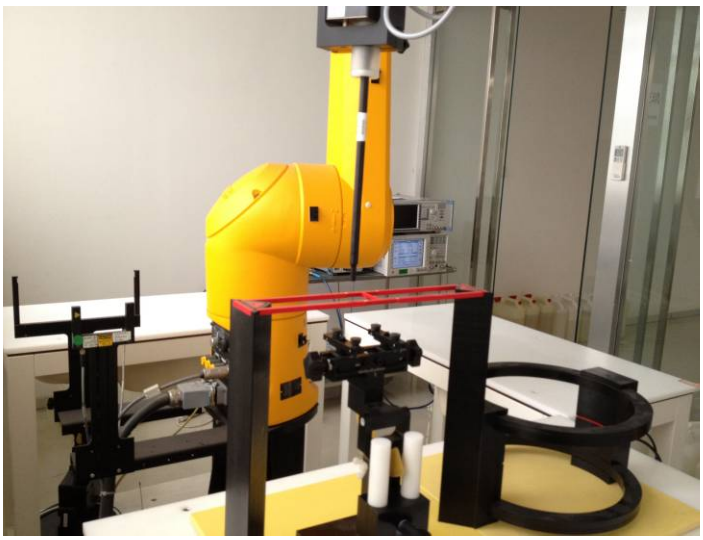


Figure 6.1 HAC Test Measurement Set-up

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.



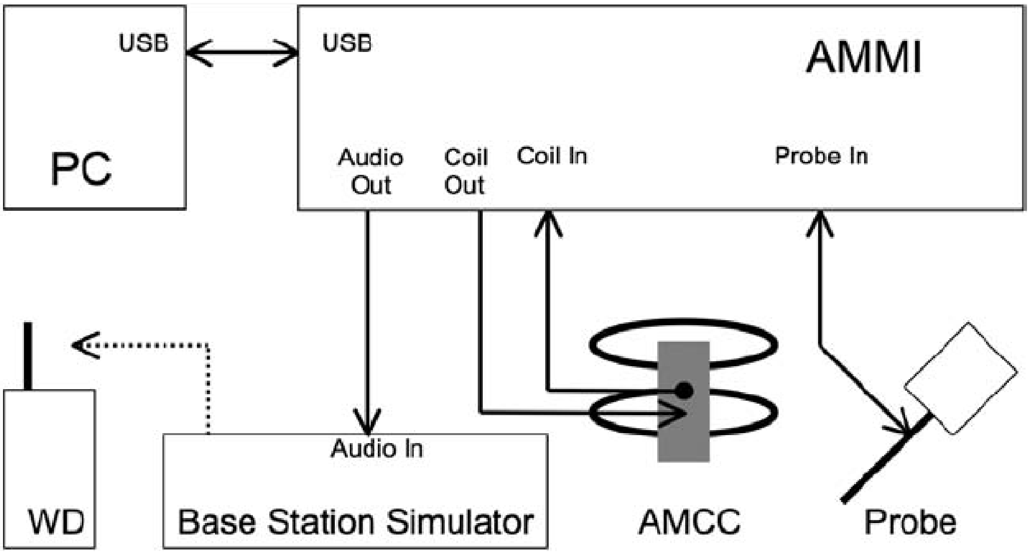


Figure 6.2 T-Coil setup with HAC Test Arch and AMCC

6.2 AM1D probe

The AM1D probe is an active probe with a single sensor. It is fully RF-shielded and has a rounded tip 6mm in diameter incorporating a pickup coil with its center offset 3mm from the tip and the sides. The symmetric signal preamplifier in the probe is fed via the shielded symmetric output cable from the AMMI with a 48V "phantom" voltage supply. The 7-pin connector on the back in the axis of the probe does not carry any signals. It is mounted to the DAE for the correct orientation of the sensor. If the probe axis is tilted 54.7 degree from the vertical, the sensor is approximately vertical when the signal connector is at the underside of the probe (cable hanging downwards).

Specification:

Frequency range	0.1~20kHz (RF sensitivity < -100dB, fully RF shielded)
Sensitivity	< -50dB A/m @ 1kHz
Pre-amplifier	40dB, symmetric
Dimensions	Tip diameter/length: 6/290mm, sensor according to ANSI-C63.19

6.3 AMCC

The Audio Magnetic Calibration coil is a Helmholtz Coil designed for calibration of the AM1D probe. The two horizontal coils generate a homogeneous magnetic field in the z direction. The DC input resistance is adjusted by a series resistor to approximately 50Ohm, and a shunt resistor of 10Ohm permits monitoring the current with a scale of 1:10

Port description:

Signal	**Connector**	**Resistance**
Coil In	BNC	Typically 50Ohm
Coil Monitor	BNO	10Ohm±1% (100mV corresponding to 1 A/m)

Specification:

Dimensions	370 x 370 x 196 mm, according to ANSI-C63.19

6.4 AMMI

Figure 6.3 AMMI front panel

The Audio Magnetic Measuring Instrument (AMMI) is a desktop 19-inch unit containing a sampling unit, a waveform generator for test and calibration signals, and a USB interface.

Specification:

Sampling rate	48 kHz / 24 bit
Dynamic range	85 dB
Test signal generation	User selectable and predefined (vis PC)
Calibration	Auto-calibration / full system calibration using AMCC with monitor output
Dimensions	482 x 65 x 270 mm

6.5 Test Arch Phantom & Phone Positioner

The Test Arch phantom should be positioned horizontally on a stable surface. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. It enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot (Dimensions: 370 x 370 x 370 mm).

The Phone Positioner supports accurate and reliable positioning of any phone with effect on near field <±0.5 dB.

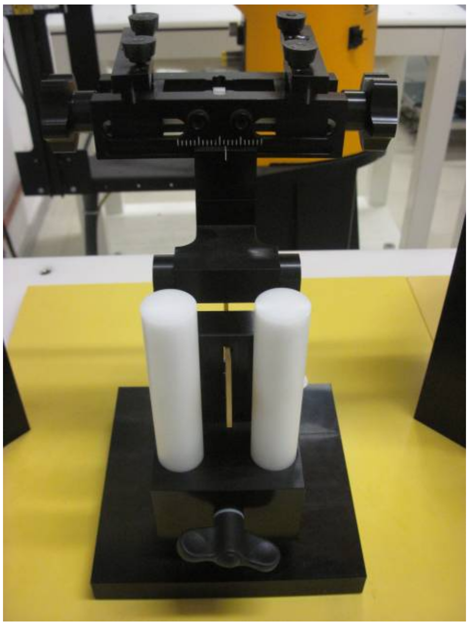


Figure 6.4 HAC Phantom & Device Holder

6.6 Robotic System Specifications

Specifications

Positioner: Stäubli Unimation Corp. Robot Model: TX90XL
Repeatability: ±0.02 mm
No. of Axis: 6

Data Acquisition Electronic (DAE) System

Cell Controller
Processor: Intel Core2
Clock Speed: 1.86 GHz
Operating System: Windows XP
Data Converter
Features: Signal Amplifier, multiplexer, A/D converter, and control logic
Software: DASY5 software
Connecting Lines: Optical downlink for data and status info.
Optical uplink for commands and clock

6.7 T-Coil measurement points and reference plane

Figure 5.5 illustrates the three standard probe orientations. Position 1 is the axial orientation of the probe coil; orientation 2 and orientation 3 are radial orientations. The space between the measurement positions is not fixed. It is recommended that a scan of the WD be done for each probe coil orientation and that the maximum level recorded be used as the reading for that orientation of the probe coil.

1) The reference plane is the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It is parallel to the centerline of the receiver area of the phone and is defined by the points of the receiver-end of the WD handset, which, in normal handset use, rest against the ear.

2) The measurement plane is parallel to, and 10 mm in front of, the reference plane.

3) The reference axis is normal to the reference plane and passes through the center of the receiver speaker section (or the center of the hole array); or may be centered on a secondary inductive source. The actual location of the measurement point shall be noted in the test report as the measurement reference point.

4) The measurement points may be located where the axial and radial field intensity measurements are optimum with regard to the requirements. However, the measurement points should be near the acoustic output of the WD and shall be located in the same half of the phone as the WD receiver. In a WD handset with a centered receiver and a circularly symmetrical magnetic field, the measurement axis and the reference axis would coincide.

5) The relative spacing of each measurement orientation is not fixed. The axial and two radial orientations should be chosen to select the optimal position.

6) The measurement point for the axial position is located 10 mm from the reference plane on the measurement axis. The actual location of the measurement point shall be noted in test reports and designated as the measurement reference point.

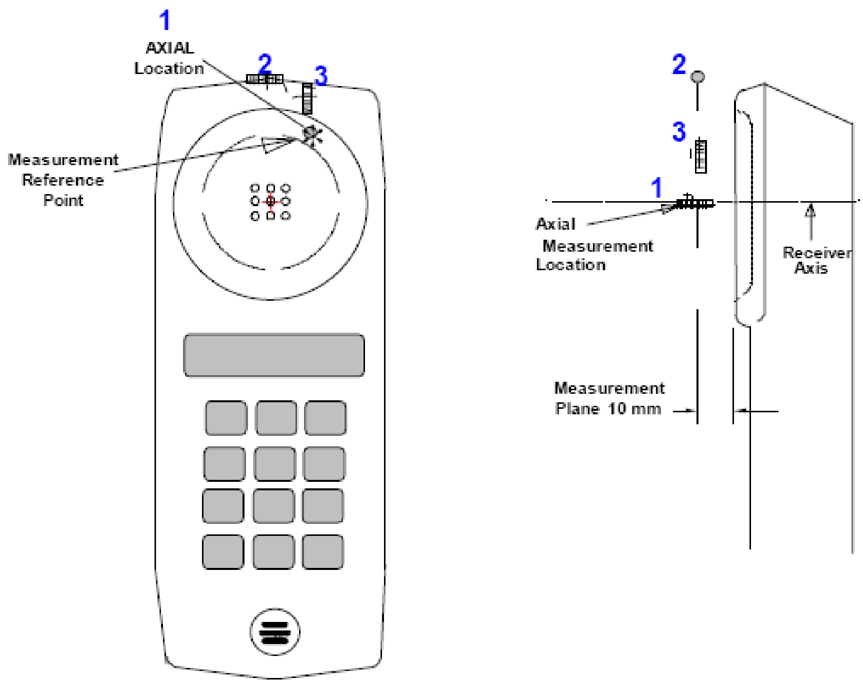


Figure 6.5 Axis and planes for WD audio frequency magnetic field measurements

7 T-Coil TEST PROCEDUERES

The following illustrate a typical test scan over a wireless communications device:

1) Geometry and signal check: system probe alignment, proper operation of the field probe, probe measurement system, other instrumentation, and the positioning system was confirmed. A surface calibration was performed before each setup change to ensure repeatable spacing and proper maintenance of the measurement plane using the test Arch.

2) Set the reference drive level of signal voice defined in C63.19 per 6.3.2.1.

3) The ambient and test system background noise (dB A/m) was measured as well as ABM2 over the full measurement. The maximum noise level must be at least 10dB below the limit of C63.19 per 7.3.2.

4) The DUT was positioned in its intended test position, acoustic output point of the device perpendicular to the field probe.

5) The DUT operation for maximum rated RF output power was configured and connected by using of coaxial cable connection to the base station simulator at the test channel and other normal operating parameters as intended for the test. The battery was ensured to be fully charged before each test. The center sub-grid was centered over the center of the acoustic output (also audio band magnetic output, if applicable). The DUT audio output was positioned tangent (as physically possible) to the measurement plane.

6) The DUT's RF emission field was eliminated from T-coil results by using a well RF-shielding of the probe, AM1D, and by using of coaxial cable connection to a Base Station Simulator. One test channel was pre-measurement to avoid this possibility.

7) Determined the optimal measurement locations for the DUT by following the three steps, coarse resolution scan, fine resolution scans, and point measurement, as described in C63.19 per 6.3.4.4.

At each measurement locations, samples in the measurement window duration were evaluated to get ABM1 and the signal spectrum. The noise measurement was performed after the scan with the signal, the same happened, just with the voice signal switched off. The ABM2 was calculated from this second scan.

8) All results resulting from a measurement point in a T-Coil job were calculated from the signal samples during this window interval. ABM values were averaged over the sequence of there samples.

9) At an optimal point measurement, the SNR (ABM1/ABM2) was calculated for axial,radial transverse and radial longitudinal orientation, and the frequency response was measured in axial axis.

10) Corrected for the frequency response after the DUT measurement since the DASY5 system had known the spectrum of the input signal by using a reference job.

11) In SEMCAD postprocessing, the spectral points are in addition scaled with the high-pass (half-band) and the A-weighting, bandwidth compensated factor (BWC) and those results are final as shown in this report.

8 T-Coil PERFORMANCE REQUIREMENTS

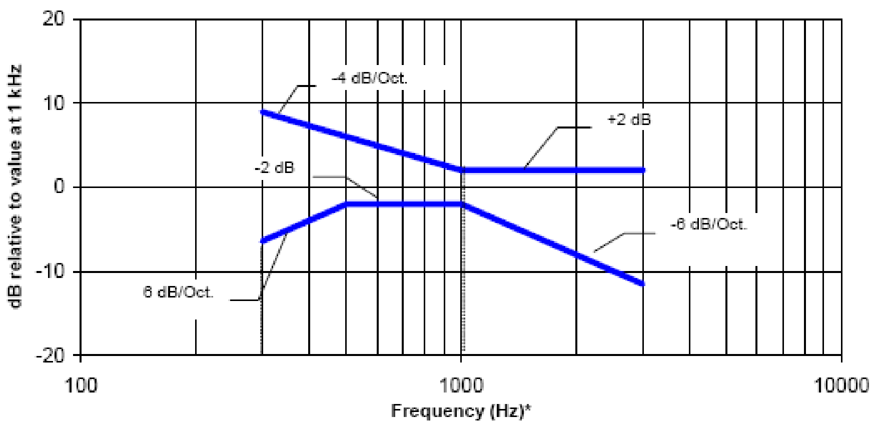
In order to be rated for T-Coil use, a WD shall meet the requirements for signal level and signal quality contained in this part.

8.1 T-Coil coupling field intensity

When measured as specified in ANSI C63.19, the T-Coil signal shall be ≥ –18 dB (A/m) at 1 kHz, in a 1/3 octave band filter for all orientations.

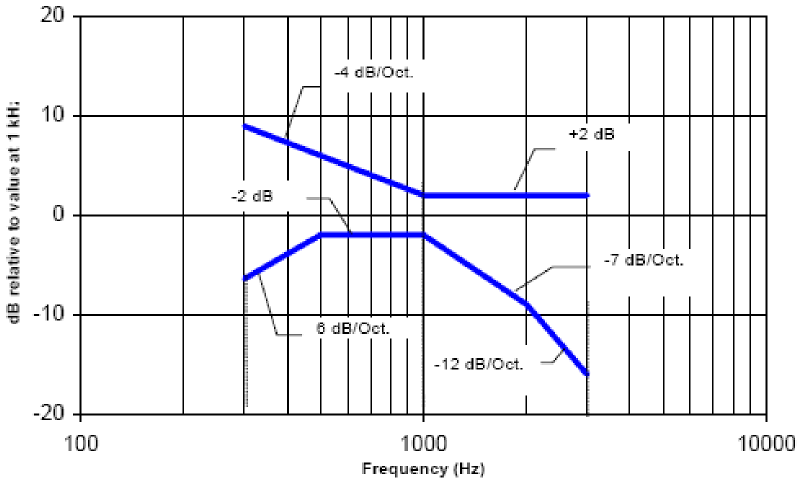
8.2 Frequency response

The frequency response of the axial component of the magnetic field, measured in 1/3 octave bands, shall follow the response curve specified in this sub-clause, over the frequency range 300 Hz to 3000 Hz. Figure 7.1 and Figure 7.2 provide the boundaries for the specified frequency. These response curves are for true field strength measurements of the T-Coil signal. Thus the 6 dB/octave probe response has been corrected from the raw readings.



NOTE—Frequency response is between 300 Hz and 3000 Hz.

Figure 8.1—Magnetic field frequency response for WDs with a field ≤ –15 dB (A/m) at 1 kHz



NOTE—Frequency response is between 300 Hz and 3000 Hz.

Figure 8.2—Magnetic field frequency response for WDs with a field that exceeds –15 dB(A/m) at 1 kHz

8.3 Signal quality

This part provides the signal quality requirement for the intended T-Coil signal from a WD. Only the RF immunity of the hearing aid is measured in T-Coil mode. It is assumed that a hearing aid can have no immunity to an interference signal in the audio band, which is the intended reception band for this mode. So, the only criteria that can be measured is the RF immunity in T-Coil mode. This is measured using the same procedure as for the audio coupling mode and at the same levels.

The worst signal quality of the three T-Coil signal measurements shall be used to determine the T-Coil mode category per Table 1

Table 1: T-Coil signal quality categories

Category	Telephone parameters WD signal quality [(signal + noise) – to – noise ratio in decibels]
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB
Category T4	> 30 dB

9 HAC T-Coil TEST DATA SUMMARY

9.1 T-Coil Coupling Field Intensity

9.1.1 Axial Field Intensity

Cell Phone Mode	Minimum limit (dB A/m)	Result (dB A/m)	Verdict
GSM 850	-18	-16.47	**Pass**
GSM 1900	-18	-12.41	**Pass**

9.1.2 Radial Field Intensity

Cell Phone Mode	Minimum limit (dB A/m)	Result (dB A/m)	Verdict
GSM 850	-18	5.21	**Pass**
GSM 1900	-18	9.32	**Pass**

9.2 Frequency Response at Axial Measurement Point

Cell Phone Mode	Frequency Response Curve	Verdict
GSM 850	Figure C.1	**Pass**
GSM 1900	Figure C.2	**Pass**

9.3 Signal Quality

Probe Position	Band	Ch.	Measurement Position (x mm, y mm)	ABM1 (dB A/m)	SNR (dB)	T category
Radial 1 (Longitudinal)	**GSM 850**	190	(-25,8.3)	-16.47	26.68	T3
	GSM 1900	661	(-25,8.3)	-12.41	32.39	T4
Radial 2 (Transversal)	**GSM 850**	190	(-12.5,20.8)	-15.57	33.34	T4
	GSM 1900	661	(4.2,-4.2)	0.92	38.09	T4
Axial	**GSM 850**	190	(12.5,4.2)	5.21	32.42	T4
	GSM 1900	661	(12.5,4.2)	9.32	39.02	T4

Note:

1. The LCD backlight is turn off, Bluetooth function is turn off and volume is adjusted to maximum level during T-Coil testing.
2. Signal strength measurement scan plots are presented in Annex B.

9.4 Total Measurement Conclusion

Probe Position	Frequency Band(MHz)	ABM1	Frequency Response	T Category
Axial	GSM 850	Pass	Pass	T3
	GSM 1900	Pass	Pass	T4
Radial 1	GSM 850	Pass	/	T4
	GSM 1900	Pass		T4
Radial 2	GSM 850	Pass	/	T4
	GSM 1900	Pass		T4

10 MEASUREMENT UNCERTAINTY

No.	Error source	Type	Uncertainty Value a_i (%)	Prob. Dist.	Div.	ABM1 ci	ABM2 ci	Std. Unc. ABM1 u_i' (%)	Std. Unc. ABM2 u_i' (%)
1	System Repeatability	A	0.016	N	1	1	1	0.016	0.016
Probe Sensitivity									
2	Reference Level	B	3.0	R	$\sqrt{3}$	1	1	3.0	3.0
3	AMCC Geometry	B	0.4	R	$\sqrt{3}$	1	1	0.2	0.2
4	AMCC Current	B	0.6	R	$\sqrt{3}$	1	1	0.4	0.4
5	Probe Positioning during Calibration	B	0.1	R	$\sqrt{3}$	1	1	0.1	0.1
6	Noise Contribution	B	0.7	R	$\sqrt{3}$	0.014 3	1	0.0	0.4
7	Frequency Slope	B	5.9	R	$\sqrt{3}$	0.1	1	0.3	3.5
Probe System									
8	Repeatability / Drift	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6
9	Linearity / Dynamic Range	B	0.6	N	1	1	1	0.4	0.4
10	Acoustic Noise	B	1.0	R	$\sqrt{3}$	0.1	1	0.1	0.6
11	Probe Angle	B	2.3	R	$\sqrt{3}$	1	1	1.4	1.4
12	Spectral Processing	B	0.9	R	$\sqrt{3}$	1	1	0.5	0.5
13	Integration Time	B	0.6	N	1	1	5	0.6	3.0

14	Field Distribution	B	0.2	R	$\sqrt{3}$	1	1	0.1	0.1
Test Signal									
15	Ref.Signal Spectral Response	B	0.6	R	$\sqrt{3}$	0	1	0.0	0.4
Positioning									
16	Probe Positioning	B	1.9	R	$\sqrt{3}$	1	1	1.1	1.1
17	Phantom Thickness	B	0.9	R	$\sqrt{3}$	1	1	0.5	0.5
18	DUT Positioning	B	1.9	R	$\sqrt{3}$	1	1	1.1	1.1
External Contributions									
19	RF Interference	B	0.0	R	$\sqrt{3}$	1	0.3	0.0	0.0
20	Test Signal Variation	B	2.0	R	$\sqrt{3}$	1	1	1.2	1.2
Combined Std. Uncertainty (ABM Field)		$u_c' = \sqrt{\sum_{i=1}^{20} c_i^2 u_i^2}$						4.1	6.1
Expanded Std. Uncertainty		$u_e = 2u_c$		N	$k = 2$			8.2	12.2

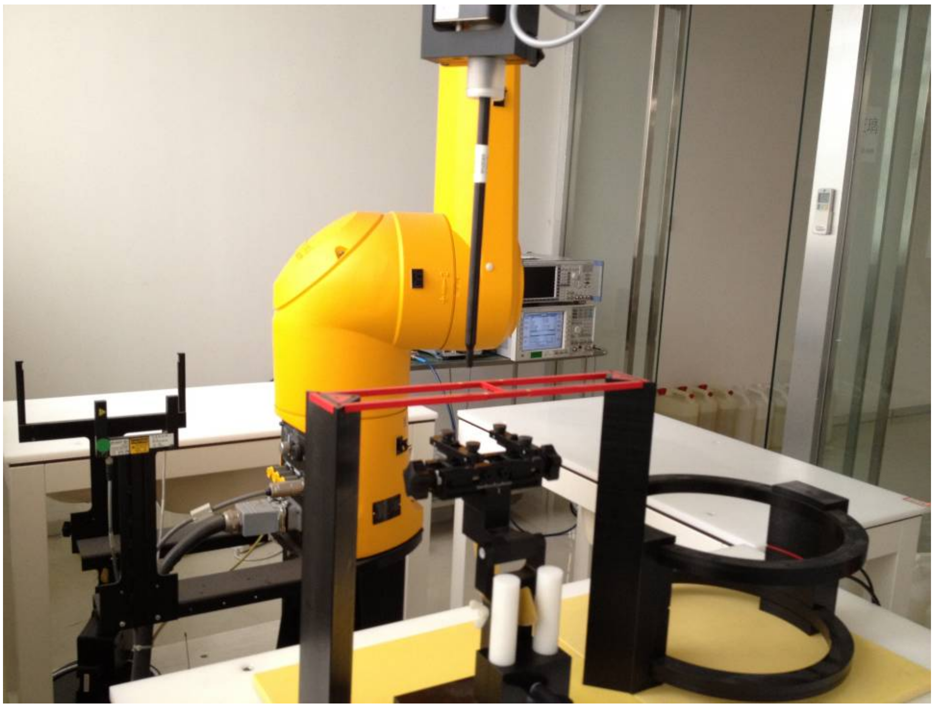
11 MAIN TEST INSTRUMENTS

Table 2: List of Main Instruments

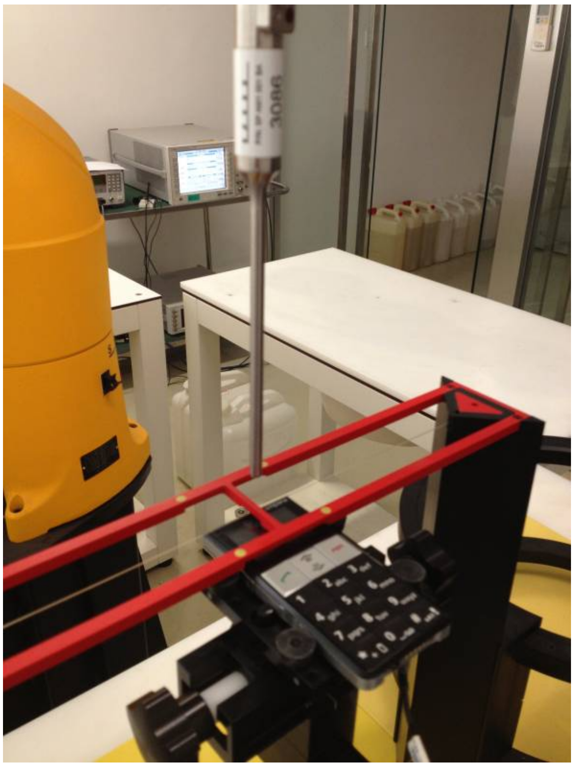
No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Audio Magnetic 1D Field Probe	AM1DV3	3086	July 19, 2012	NCR
02	Audio Magnetic Calibration Coil	AMCC	1105	NCR	NCR
03	Audio Measuring Instrument	AMMI	1121	NCR	NCR
04	HAC Test Arch	N/A	1150	NCR	NCR
05	DAE	DAE4	786	November 20, 2012	One year
06	Software	DASY5 Version 52.8.4.1052	N/A	NCR	NCR
07	Software	SEMCAD Version 14.6.8	N/A	NCR	NCR
08	Universal Radio Communication Tester	CMU 200	114825	January 18, 2013	One year

END OF REPORT BODY

ANNEX A TEST LAYOUT



Picture A1: HAC T-Coil System Layout



Picture A2: HAC T-Coil EUT setup

ANNEX B TEST PLOTS

T-Coil GSM 850 X longitudinal

Date: 3/04/2013
Electronics: DAE4 Sn786
Medium: Air
Medium parameters used: $\sigma = 0$ S/m, $\varepsilon r = 1$; $\rho = 0$ kg/m3
Communication System: GSM Frequency: 836.6 MHz Duty Cycle: 1:8.30042
Probe: AM1DV3 - 3086

Configuration/General Scans/x (longitudinal) (2007) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 35.506
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

Category	**Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]**
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB
Category T4	> 30 dB

Cursor:
ABM1/ABM2 = 26.68 dB
ABM1 comp = -16.47 dBA/m
BWC Factor = 0.15 dB
Location: -25, 8.3, 3.7 mm

Configuration/General Scans/x (longitudinal) (2007) 4.2mm 50 x 50/ABM Signal(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 35.506
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

Category	**Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]**
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB

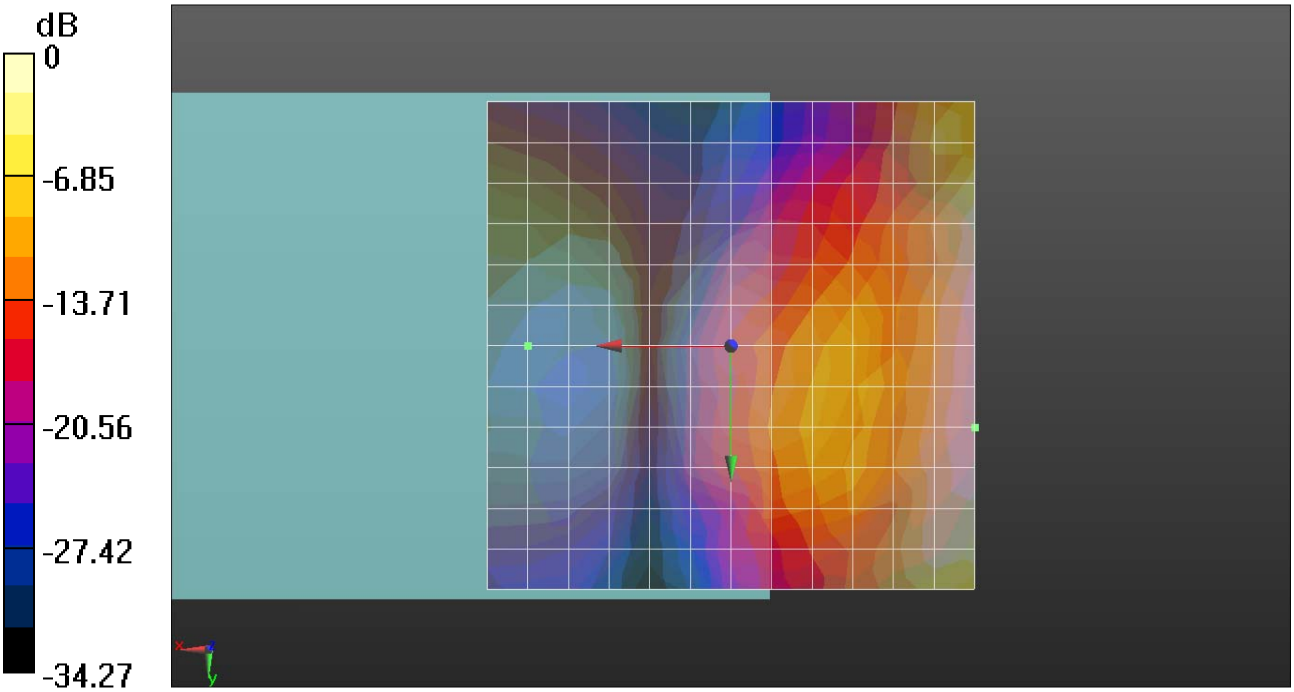
Category T3	20 dB to 30 dB
Category T4	> 30 dB

Cursor:

ABM1 comp = -0.15 dBA/m

BWC Factor = 0.15 dB

Location: 20.8, 0, 3.7 mm



0 dB = 21.57 = 26.68 dB

SEMCAD X Version 14.6.8 (7028)

Fig B.1 T-Coil GSM 850

T-Coil GSM 850 Y transversal

Date: 3/04/2013
Electronics: DAE4 Sn786
Medium: Air
Medium parameters used: $\sigma = 0$ S/m, $\varepsilon r = 1$; $\rho = 0$ kg/m3
Communication System: GSM Frequency: 836.6 MHz Duty Cycle: 1:8.30042
Probe: AM1DV3 - 3086

Configuration/General Scans/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 35.506
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

Category	**Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]**
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB
Category T4	> 30 dB

Cursor:

ABM1/ABM2 = 33.34 dB
ABM1 comp = -15.57 dBA/m
BWC Factor = 0.15 dB
Location: -12.5, 20.8, 3.7 mm

Configuration/General Scans/y (transversal) 4.2mm 50 x 50/ABM Signal(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 35.506
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

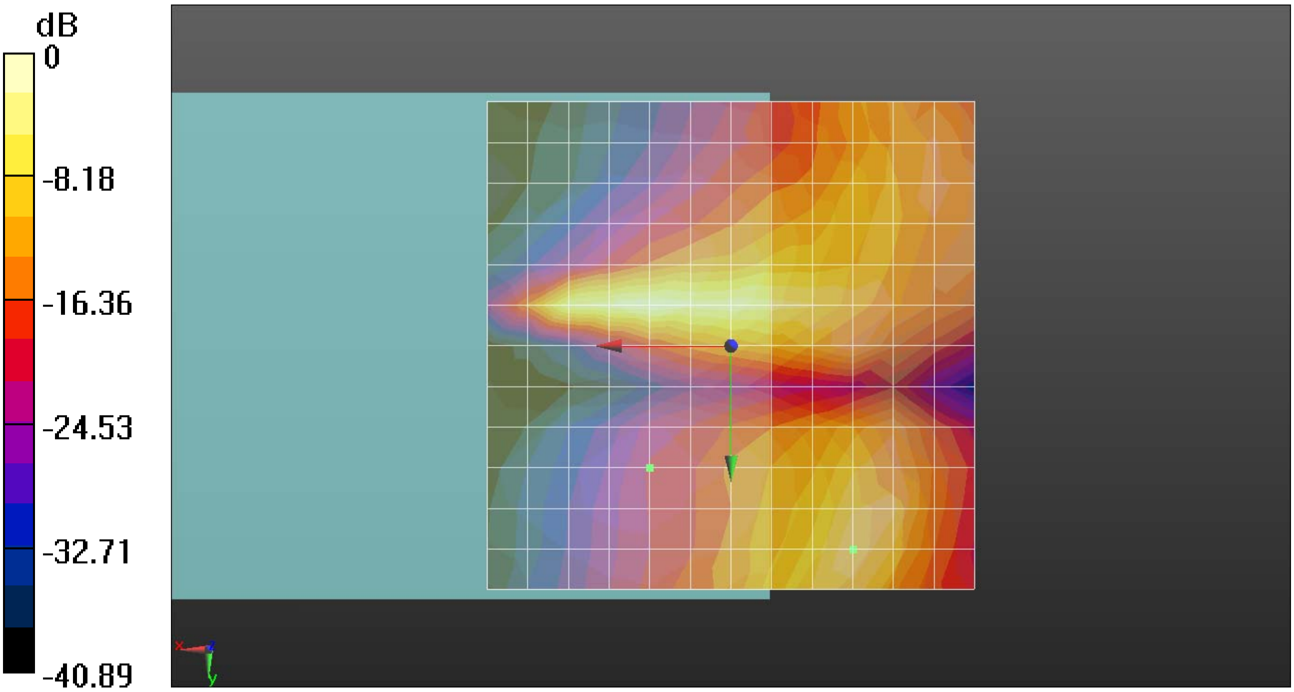
Category	**Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]**
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB
Category T4	> 30 dB

Cursor:

ABM1 comp = -1.80 dBA/m

BWC Factor = 0.15 dB

Location: 8.3, 12.5, 3.7 mm



0 dB = 46.47 = 33.34 dB

SEMCAD X Version 14.6.8 (7028)

Fig B.2 T-Coil GSM 850

T-Coil GSM 850 Z Axial

Date: 3/04/2013
Electronics: DAE4 Sn786
Medium: Air
Medium parameters used: σ = 0 S/m, εr = 1; ρ = 0 kg/m3
Communication System: GSM Frequency: 836.6 MHz Duty Cycle: 1:8.30042
Probe: AM1DV3 - 3086

Configuration/General Scans/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 35.506
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

Category	**Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]**
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB
Category T4	> 30 dB

Cursor:
ABM1/ABM2 = 32.42 dB
ABM1 comp = 5.21 dBA/m
BWC Factor = 0.15 dB
Location: 12.5, 4.2, 3.7 mm

Configuration/General Scans/z (axial) 4.2mm 50 x 50/ABM Signal(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 35.506
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

Category	**Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]**
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB

Category T4	> 30 dB

Cursor:

ABM1 comp = 6.35 dBA/m

BWC Factor = 0.15 dB

Location: 8.3, 0, 3.7 mm

Configuration/General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav

Output Gain: 69.536

Measure Window Start: 300ms

Measure Window Length: 2000ms

BWC applied: 10.80 dB

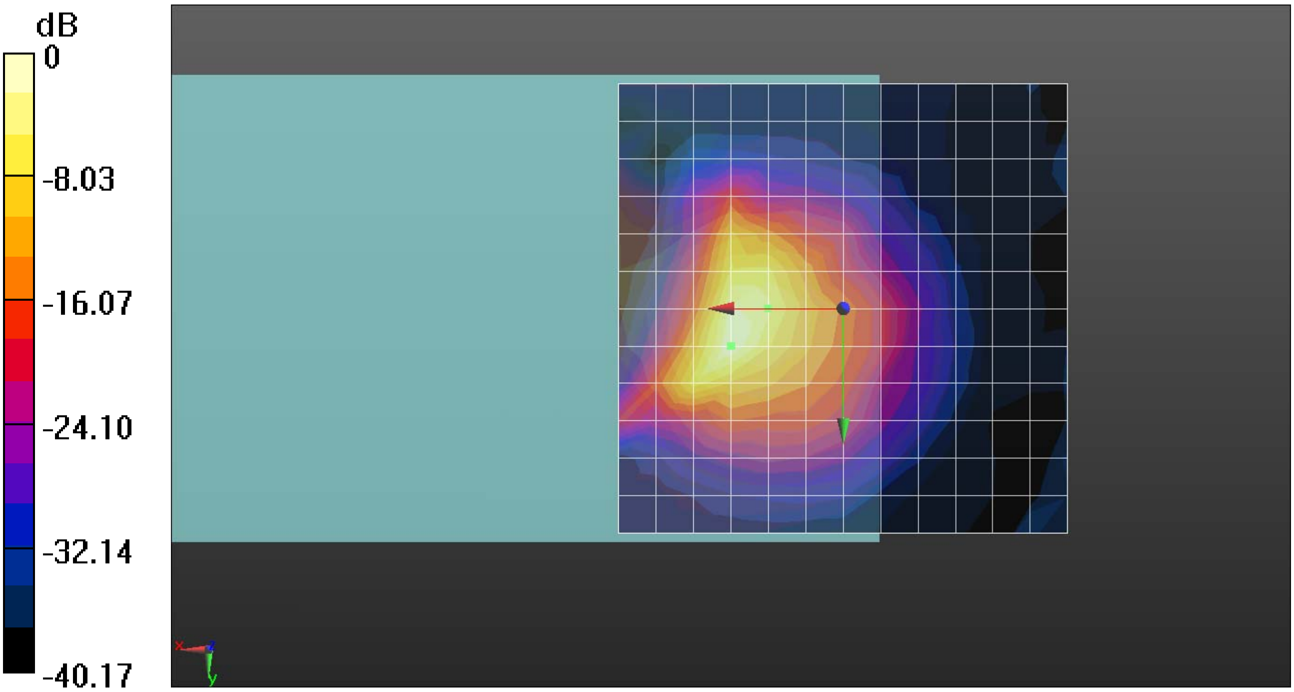
Device Reference Point: 0, 0, -6.3 mm

Cursor:

Diff = 0.63 dB

BWC Factor = 10.80 dB

Location: 12.5, 4.2, 3.7 mm



0 dB = 41.79 = 32.42 dB

SEMCAD X Version 14.6.8 (7028)

Fig B.3 T-Coil GSM 850

T-Coil GSM 1900 X longitudinal

Date: 3/04/2013
Electronics: DAE4 Sn786
Medium: Air
Medium parameters used: σ = 0 S/m, εr = 1; ρ = 0 kg/m3
Communication System: GSM Frequency: 1880 MHz Duty Cycle: 1:8.30042
Probe: AM1DV3 - 3086

Configuration/General Scans 2/x (longitudinal) (2007) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 35.506
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

Category	**Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]**
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB
Category T4	> 30 dB

Cursor:
ABM1/ABM2 = 32.39 dB
ABM1 comp = -12.41 dBA/m
BWC Factor = 0.15 dB
Location: -25, 8.3, 3.7 mm

Configuration/General Scans 2/x (longitudinal) (2007) 4.2mm 50 x 50/ABM Signal(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 35.506
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

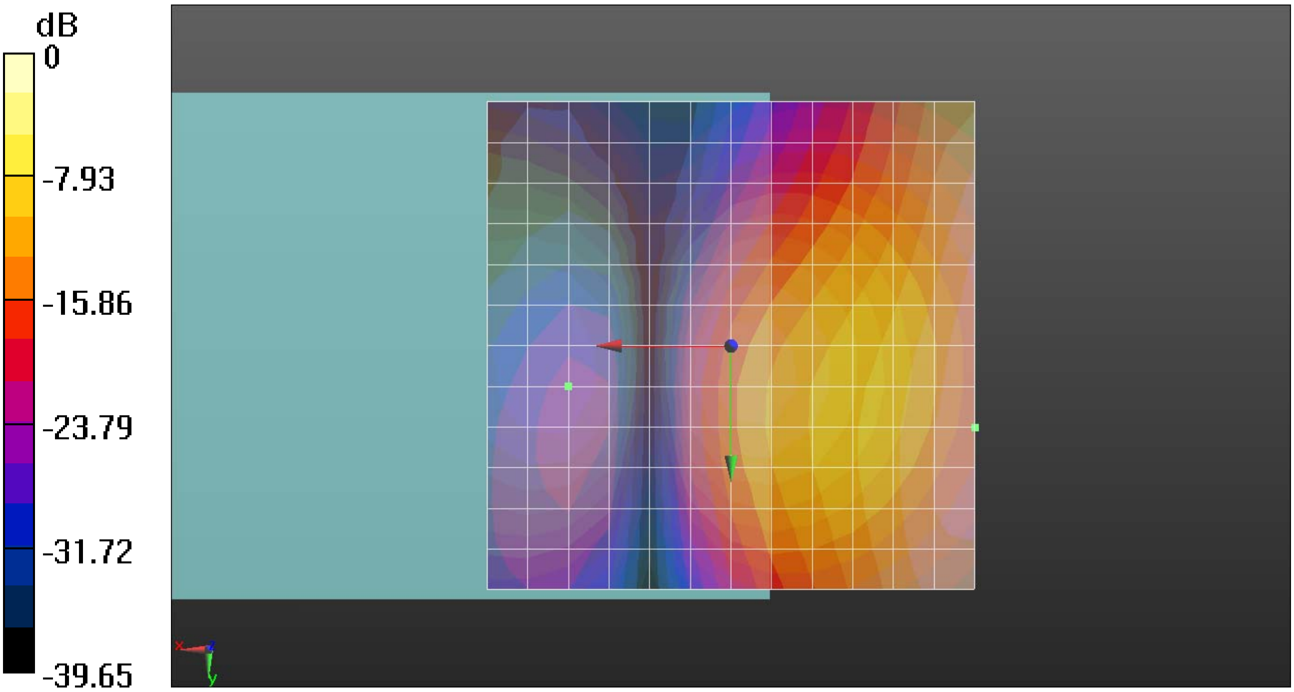
Category	**Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]**
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB
Category T4	> 30 dB

Cursor:

ABM1 comp = 3.21 dBA/m

BWC Factor = 0.15 dB

Location: 16.7, 4.2, 3.7 mm



0 dB = 41.62 = 32.39 dB

SEMCAD X Version 14.6.8 (7028)

Fig B.4 T-Coil GSM 1900

T-Coil GSM 1900 Y transversal

Date: 3/04/2013
Electronics: DAE4 Sn786
Medium: Air
Medium parameters used: σ = 0 S/m, εr = 1; ρ = 0 kg/m3
Communication System: GSM Frequency: 1880 MHz Duty Cycle: 1:8.30042
Probe: AM1DV3 - 3086

Configuration/General Scans 2/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 35.506
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

Category	**Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]**
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB
Category T4	> 30 dB

Cursor:
ABM1/ABM2 = 38.09 dB
ABM1 comp = 0.92 dBA/m
BWC Factor = 0.15 dB
Location: 4.2, -4.2, 3.7 mm

Configuration/General Scans 2/y (transversal) 4.2mm 50 x 50/ABM Signal(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 35.506
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

Category	**Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]**
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB

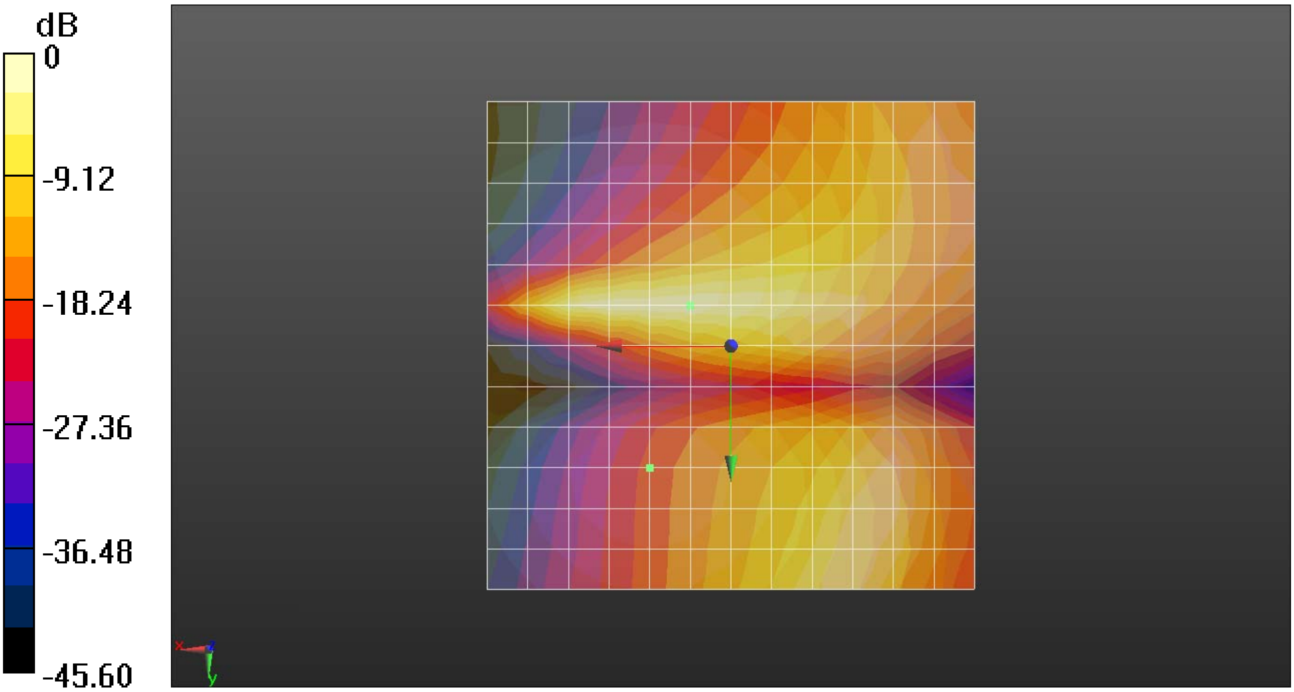
Category T4	> 30 dB

Cursor:

ABM1 comp = 2.50 dBA/m

BWC Factor = 0.15 dB

Location: 8.3, 12.5, 3.7 mm



0 dB = 80.28 = 38.09 dB

SEMCAD X Version 14.6.8 (7028)

Fig B.5 T-Coil GSM 1900

T-Coil GSM 1900 Z Axial

Date: 3/04/2013
Electronics: DAE4 Sn786
Medium: Air
Medium parameters used: σ = 0 S/m, εr = 1; ρ = 0 kg/m3
Communication System: GSM Frequency: 1880 MHz Duty Cycle: 1:8.30042
Probe: AM1DV3 - 3086

Configuration/General Scans 2/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 35.506
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

Category	**Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]**
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB
Category T4	> 30 dB

Cursor:
ABM1/ABM2 = 39.02 dB
ABM1 comp = 9.32 dBA/m
BWC Factor = 0.15 dB
Location: 12.5, 4.2, 3.7 mm

Configuration/General Scans 2/z (axial) 4.2mm 50 x 50/ABM Signal(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 35.506
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

Category	**Telephone parameters WD signal quality [(signal+noise)-to-noise ratio in decibels]**
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB
Category T4	> 30 dB

Cursor:

ABM1 comp = 10.37 dBA/m

BWC Factor = 0.15 dB

Location: 8.3, 4.2, 3.7 mm

Configuration/General Scans 2/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav

Output Gain: 69.536

Measure Window Start: 300ms

Measure Window Length: 2000ms

BWC applied: 10.80 dB

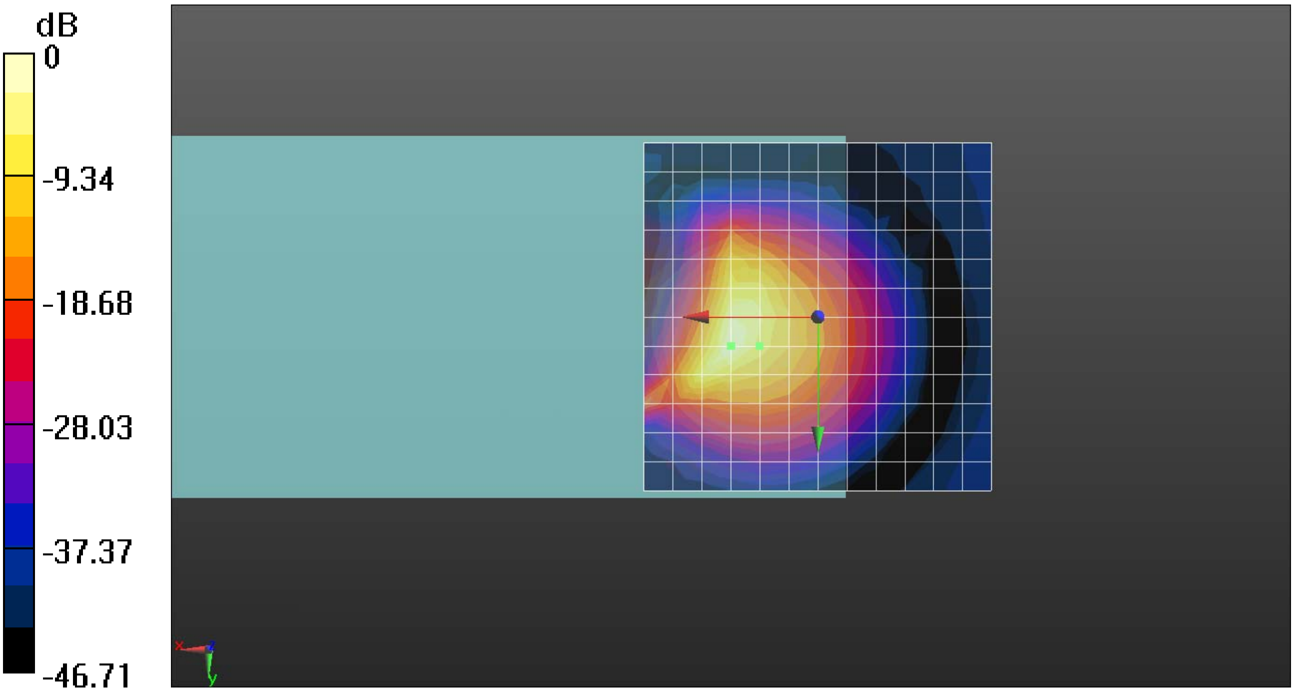
Device Reference Point: 0, 0, -6.3 mm

Cursor:

Diff = 0.37 dB

BWC Factor = 10.80 dB

Location: 12.5, 4.2, 3.7 mm



0 dB = 89.35 = 39.02 dB

SEMCAD X Version 14.6.8 (7028)

Fig B.6 T-Coil GSM 1900

ANNEX C FREQUENCY REPONSE CURVES

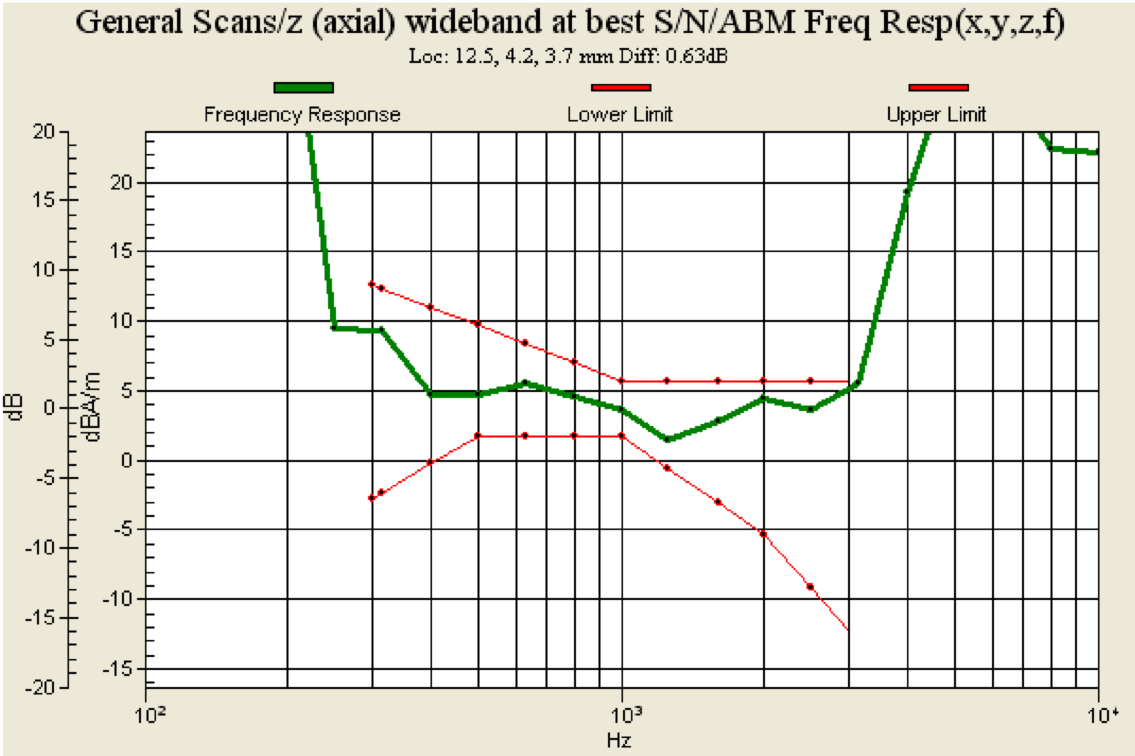


Figure C.1 Frequency Response of GSM 850

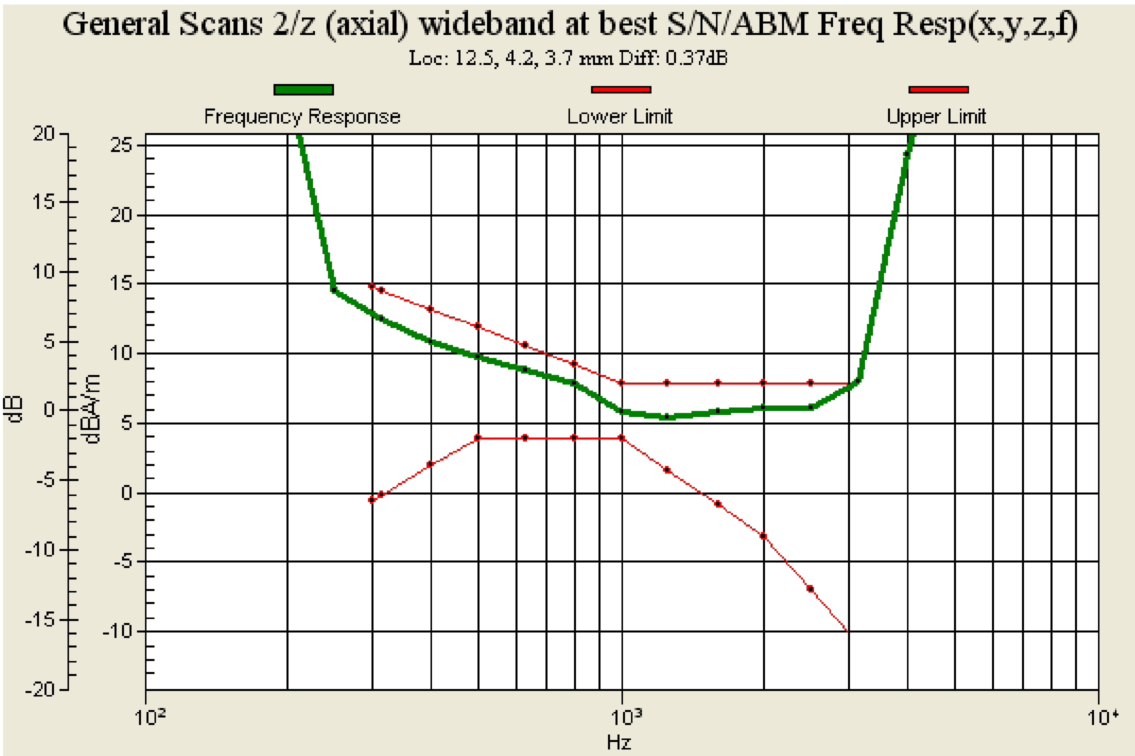


Figure C.2 Frequency Response of GSM 1900

ANNEX D PROBE CALIBRATION CERTIFICATE

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

ilac-MRA

SWISS CALIBRATION

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S 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 **TMC-SZ (Auden)**

Certificate No: AM1D-3086_Jul12

CALIBRATION CERTIFICATE

受控文件
TMC-CC-12-272 SZ 02

Object	AM1DV3 - SN: 3086
Calibration procedure(s)	QA CAL-24.v3 Calibration procedure for AM1D magnetic field probes and TMFS in the audio range
Calibration date:	July 19, 2012

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	28-Sep-11 (No:11450)	Sep-12
Reference Probe AM1DV3	SN: 3000	17-Aug-11 (No. AM1D-3000_Aug11)	Aug-12
DAE4	SN: 781	29-May-12 (No. DAE4-781_May12)	May-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
AMCC	1050	12-Oct-11 (in house check Oct-11)	Oct-13

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Fin Bomholt	R&D Director	

Issued: July 19, 2012

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

References

[1] ANSI C63.19-2007
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

[2] DASY5 manual, Chapter: Hearing Aid Compatibility (HAC) T-Coil Extension

Description of the AM1D probe

The AM1D 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 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 nominally 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 a DASY system, the probe must be operated with the special probe cup provided (larger diameter).

Methods Applied and Interpretation of Parameters

- *Coordinate System:* The AM1D probe is mounted in the DASY system for operation with a HAC Test Arch phantom with AMCC Helmholtz calibration coil according to [2], with the tip pointing to "southwest" orientation.
- *Functional Test:* The functional test preceding calibration includes test of
  Noise level
  RF immunity (1kHz AM modulated signal). The shield of the probe cable must be well connected.
  Frequency response verification from 100 Hz to 10 kHz.
- *Connector Rotation:* The connector at the end of the probe does not carry any signals and is used for fixation to the DAE only. The probe is operated in the center of the AMCC Helmholtz coil using a 1 kHz magnetic field signal. Its angle is determined from the two minima at nominally +120° and –120° rotation, so the sensor in the tip of the probe is aligned to the vertical plane in z-direction, corresponding to the field maximum in the AMCC Helmholtz calibration coil.
- *Sensor Angle:* The sensor tilting in the vertical plane from the ideal vertical direction is determined from the two minima at nominally +120° and –120°. DASY system uses this angle to align the sensor for radial measurements to the x and y axis in the horizontal plane.
- *Sensitivity:* With the probe sensor aligned to the z-field in the AMCC, the output of the probe is compared to the magnetic field in the AMCC at 1 kHz. The field in the AMCC Helmholtz coil is given by the geometry and the current through the coil, which is monitored on the precision shunt resistor of the coil.

AM1D probe identification and configuration data

Item	**AM1DV3** Audio Magnetic 1D Field Probe
Type No	SP AM1 001 BA
Serial No	**3086**

Overall length	296 mm
Tip diameter	6.0 mm (at the tip)
Sensor offset	3.0 mm (centre of sensor from tip)
Internal Amplifier	20 dB

Manufacturer / Origin	Schmid & Partner Engineering AG, Zürich, Switzerland
Manufacturing date	May 28, 2010
Last calibration date	February 14, 2011

Calibration data

Connector rotation angle	(in DASY system)	**204.5 °**	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	**0.72 °**	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	**0.00743 V / (A/m)**	+/- 2.2 % (k=2)

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