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HAC T-Coil Test Report

Test Report No.	:	1008FS13-02
Applicant	:	Huawei Technologies Co.,Ltd
Product Type	:	Mobilephone
Model Name	:	HUAWEI C8600/HUAWEI M860
FCC ID	:	QISM860
Dates of Test	:	Aug. 12, 2010
Test Environment	:	Ambient Temperature： 22 ±2 ℃ Relative Humidity： 40 - 70 %
Test Lab	:	Changan Lab
HAC T-Coil Standard	:	ANSI C63.19-2007
C63.19 T-Coil Rated Category	:	T4 (Audio Band Magnetic)
Statement of Compliance	:	FCC 47 CFR §20.19. The measurements were performed to ensure compliance to the ANSI C63.19-2007 standard. It also declares that the product was tested in accordance with the appropriate measurement standards, guidelines and recommended practices.

1. The test operations are cautiously performed with due diligence. The test results are as attached.
2. The test results are generated under the chamber environment of A Test Lab Techno Corp. A Test Lab Techno Corp. does not assume any responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples.
3. The measurement report shall be approved in writing by A Test Lab Techno Corp. It may only be reproduced or published in full. This report shall not be reproduced except in full, without the written approval of A Test Lab Techno Corp.
4. This document may be altered or revised by A Test Lab Techno Corp. personnel only and any modification shall be noted in the revision section of the document.

Sam Chuang **Sep. 02, 2010**
Approval Signer

Alex Wu **Sep. 02, 2010**
Testing Engineer

Contents

1. Description of Equipment Under Test (EUT) 3
2. Description of the Test Procedure 4
  2.1 Test Arch and Device Holder 4
  2.2 Test Positions 4
  2.3 T-coil Scan Procedures 5
  2.4 Measurement procedure and used test signals 5
  2.5 T-coil Requirements and Category Limits 5
  2.6 Measurement Uncertainty 7
3. Description of The Test Equipment 8
  3.1 Measurement system and components 8
  3.2 Measurement Equipment 9
4. Test Conditions 10
  4.1 Temperature and Humidity 10
  4.2 WD Control 10
  4.3 WD Parameters 10
  4.4 Audio Band Magnetic 10
  4.5 System Specifications 11
5. Summary of HAC T-Coil Signal Test Report 12
  5.1 Description of the Equipment under Test (EUT) 12
  5.2 Summary of T-Coil Test Results 12
Appendix A - Measurement Scans 16
Appendix B - Measurement Uncertainty 25
Appendix C - Calibration 26

1. Description of Equipment Under Test (EUT)

Applicant	:	Huawei Technologies Co.,Ltd
Applicant Address	:	Bantian,Longgang District
Manufacturer	:	Huawei Technologies Co.,Ltd
Manufacturer Address	:	Bantian,Longgang District
EUT Type	:	Mobilephone
Model Name	:	HUAWEI C8600/HUAWEI M860
FCC ID	:	QISM860
Hardware Version	:	HC1M860M
Software Version	:	M860V100R001C153B225
EUT Type	:	Production Unit
Battery Option	:	HB4F1 (Li-polymer battery, 3.7Vdc, 1500mAh)

2. Description of the Test Procedure

2.1 Test Arch and Device Holder

The test device was placed in the Device Holder (illustrated below) that is supplied by SPEAG. Using this positioner the tested device is positioner under Test Arch.

Figure 1. WD Holder

2.2 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.

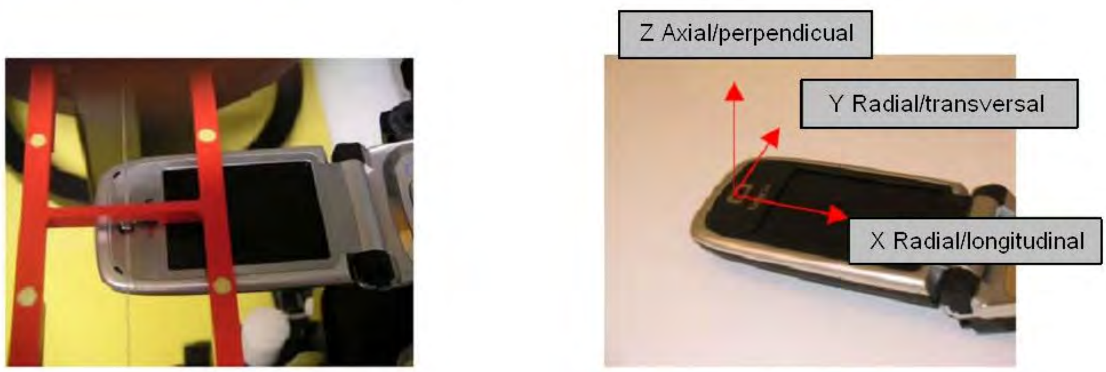


Figure 2. Photo of a typical device positioned under Test Arch and coordinate system

2.3 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.

2.4 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.

2.5 T-coil Requirements and Category Limits

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

Frequency Response

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

Frequency response is between 300 Hz and 3000 Hz.

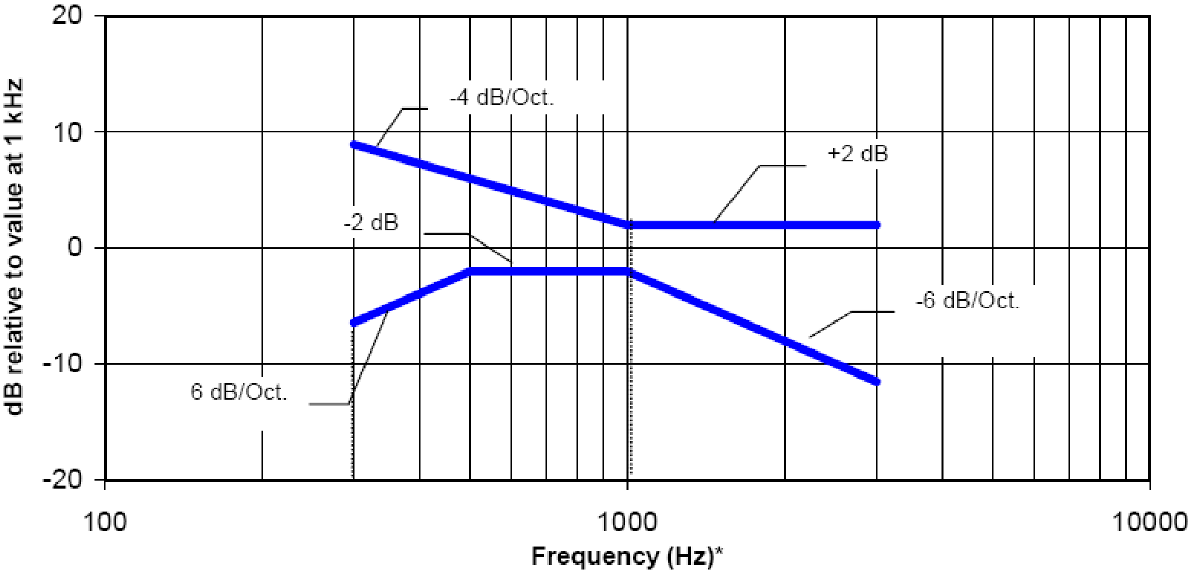


Figure 3. Magnetic field frequency response for WDs with a field ≤ -15 dB (A/m) at 1 kHz

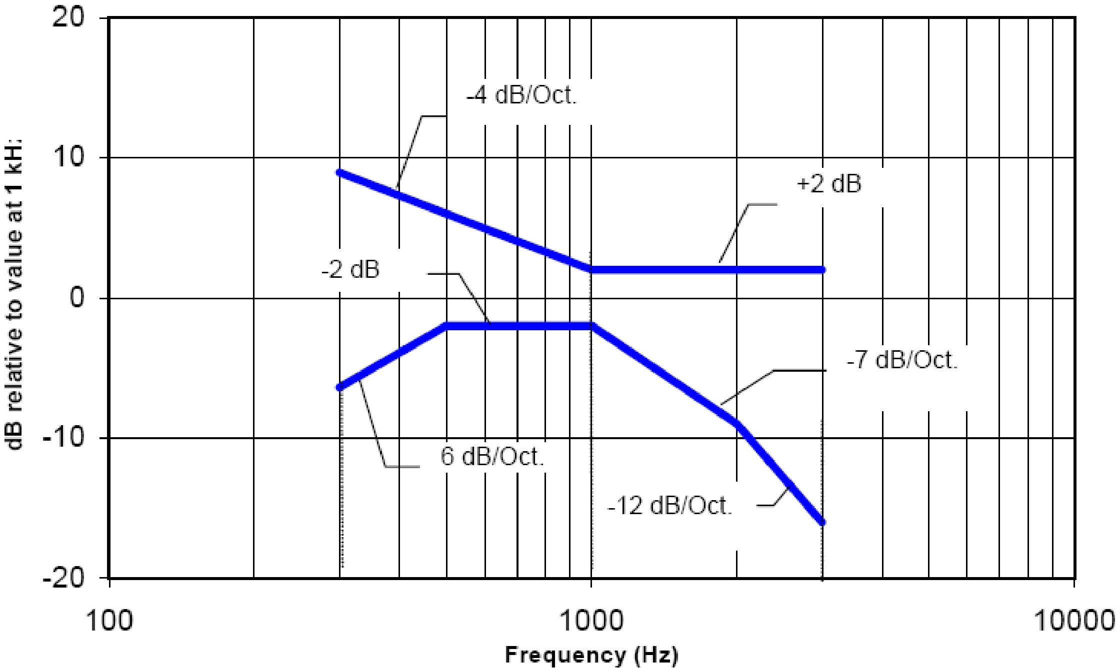


Figure 4. Magnetic field frequency response for WDs with a field that exceeds -15 dB(A/m) at 1 kHz

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

Table 1. T-Coil signal quality categories

2.6 Measurement Uncertainty

Measurement uncertainty budget presented in Appendix B.

3. Description of The Test Equipment

3.1 Measurement system and components

The measurements were performed using an automated near-field scanning system, DASY5 software version 5.0, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland.
Components and signal paths of used measurement system are pictured below:

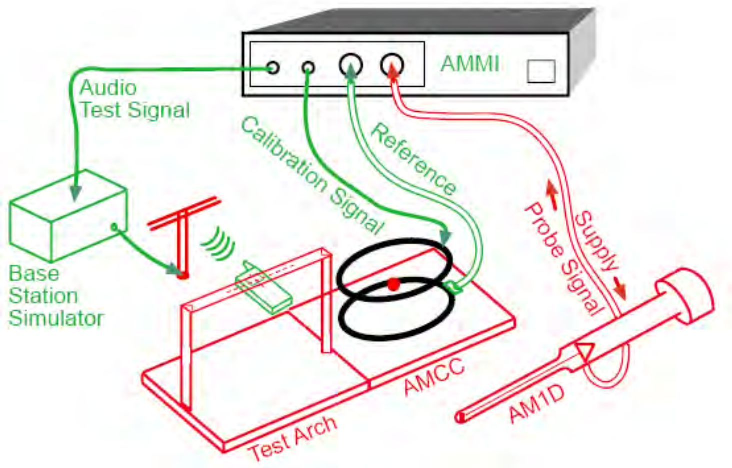


Figure 5. T-Coil Measurement system

3.1.1 Audio Magnetic Probe AM1DV2

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

3.1.2 Audio Magnetic Measurement Instrument AMMI

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

3.1.3 Audio Magnetic Calibration Coil AMCC

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

3.1.4 WD position

The WD position 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 position and test arch conforms to the requirements of ANSI C63.19.

The SPEAG device holder (see Section 2.1) was used to position the test device in all tests.

3.1.5 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.

3.2 Measurement Equipment

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Data Acquisition Electronics	DAE4	779	Jan. 21, 2010	Jan. 21, 2011
SPEAG	Audio Magnetic 1D Field Probe AM1DV2	SP AM1 001 AF	1017	Feb. 23, 2010	Feb. 23, 2011
SPEAG	Device Holder	N/A	N/A	NCR	NCR
SPEAG	AMCC	SD HAC P02 AB	1011	NCR	NCR
SPEAG	AMMI	SE UMS 010AA	1001	NCR	NCR
SPEAG	Software	DASY5 V5.0 Build 119	N/A	NCR	NCR
SPEAG	Software	SEMCAD X V13.2 Build 87	N/A	NCR	NCR
SPEAG	Measurement Server	SE UMS 011 AA	1025	NCR	NCR
Rohde & Schwarz	Universal Radio Communication Tester	CMU200	112387	Mar. 15, 2010	Mar. 15, 2011

4. Test Conditions

4.1 Temperature and Humidity

Ambient temperature (℃):	19 to 25
Ambient humidity (RH %):	40 to 70

4.2 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.

4.3 WD Parameters

HAC mode was switched on from the WD user interface, volume setting was 1/10 and microphone was muted.

4.4 Audio Band Magnetic

The purpose of the HAC T-Coil Extension is to add the capability of Audio Band Magnetic (ABM) measurements according to standard ANSI-C63.19 [1]. Together with the HAC RF extension, it allows complete characterization of the emissions of a wireless device (WD). The signals measured during these tests represent the field picked up by the T-Coil of a hearing aid. This application note describes the measurements required for the Wireless device T-Coil signal test that is described in ANSI-C63.19

4.5 System Specifications

Active Audio Magnetic Field Probe (AM1DV2) Description

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 40dB 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 angle of 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 below.

Figure 6.
Audio Magnetic Field Probe

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.

5. Summary of HAC T-Coil Signal Test Report

5.1 Description of the Equipment under Test (EUT)

Modes and Bands of Operation	CDMA Cellular Band	CDMA PCS Band	CDMA AWS Band
Modulation Mode	QPSK	QPSK	QPSK
Duty Cycle	1/1	1/1	1/1
Transmitter Frequency Range (MHz)	824.7 - 848.3	1851.2 - 1908.8	1710 - 1755

5.2 Summary of T-Coil Test Results

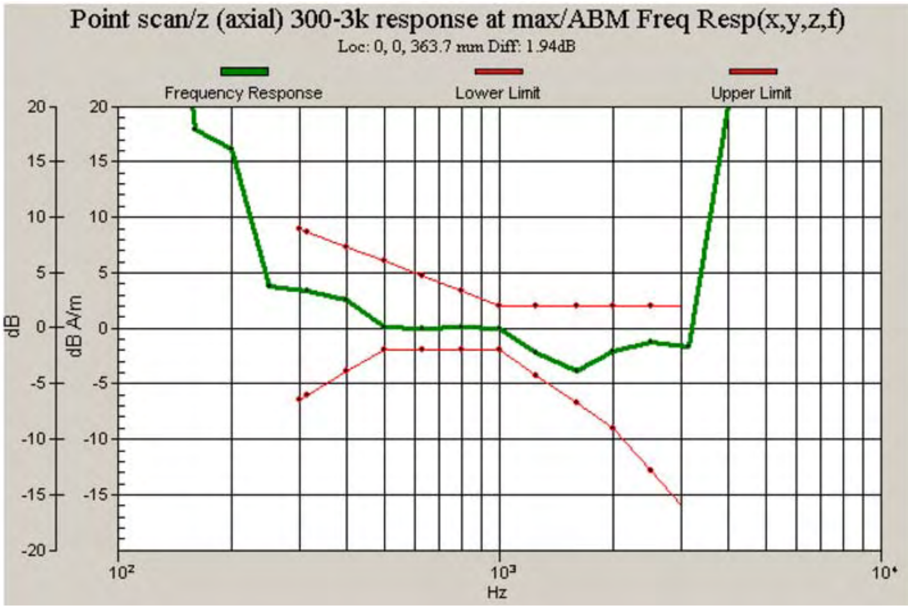
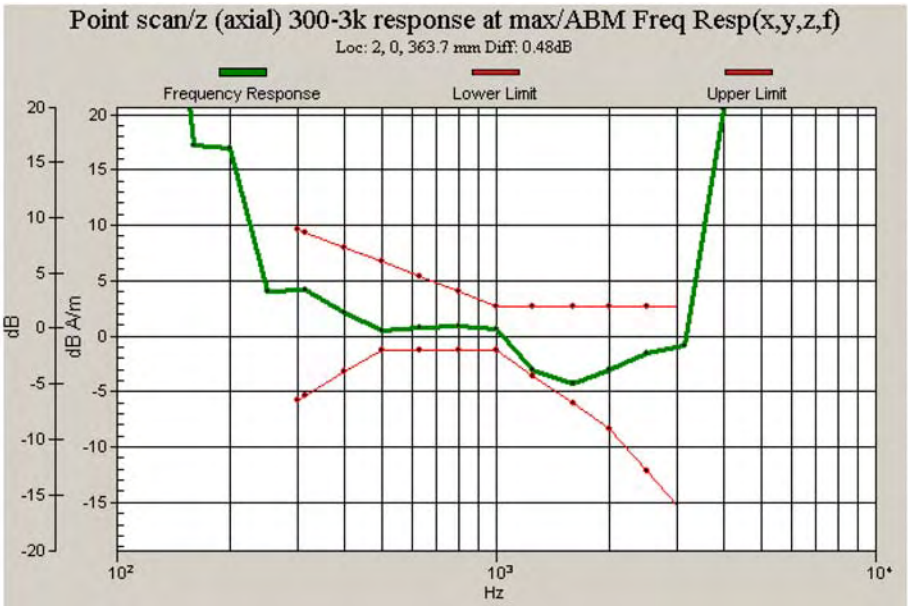
5.2.1 Results

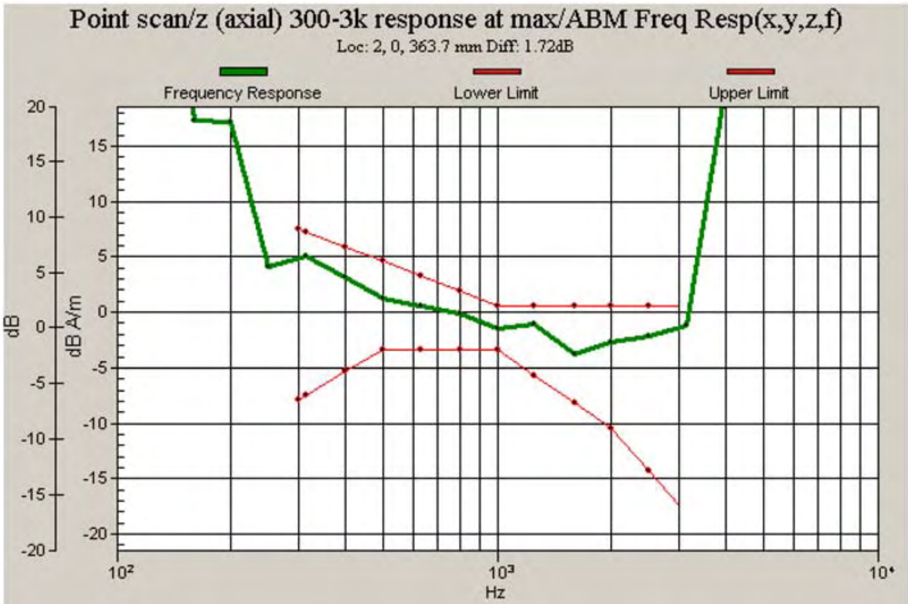
Measurement position coordinates are defined as deviation from earpiece center in millimeters. Coordinate system is defined in chapter 4.2

Axial measurement location was defined by the manufacturer of the device.

CDMA									
	Radial 1 (longitudinal)			Radial 2 (transversal)			Axial		
Mode	Cellular Band	PCS Band	AWS Band	Cellular Band	PCS Band	AWS Band	Cellular Band	PCS Band	AWS Band
Measurement position (x,y) [mm]	(-8,0)	(-8,2)	(-6,0)	(2,-6)	(2,-4)	(2,-6)	(0,0)	(2,0)	(2,0)
Signal strength [dB A/m]	-9.23	-8.75	-9.09	-8.25	-8.26	-8.20	-2.69	-0.01	0.43
Ambient back round noise ABM [dB A/m]	-50.23	-51.30	-50.46	-48.79	-48.27	-48.57	-53.45	-52.49	-52.09
ABM2 [dB A/m]	-48.09	-48.54	-47.73	-48.14	-48.25	-48.49	-48.31	-48.74	-49.23
Signal quality [dB]	38.90	39.80	38.60	39.90	40.00	40.30	45.60	48.70	49.70

Note: Plots of the signal strength Measurement scans are presented in Appendix A.

Frequency Response	
CDMA Cellular Band	
CDMA PCS Band	

Frequency Response	
CDMA AWS Band	

5.2.2 T-Coil Coupling Field Intensity

Axial Field Intensity

Cell Phone Mode	Minimum limit [dB (A/m)]	Result [dB (A/m)]	Verdict
CDMA Cellular Band	-18	-2.69	Pass
CDMA PCS Band	-18	-0.01	Pass
CDMA AWS Band	-18	0.43	Pass

Radial Field Intensity

Cell Phone Mode	Minimum limit [dB (A/m)]	Result [dB (A/m)]	Verdict
CDMA Cellular Band	-18	-8.25	Pass
CDMA PCS Band	-18	-8.26	Pass
CDMA AWS Band	-18	-8.20	Pass

5.2.3 Frequency Response at Axial Measurement Point

Cell Phone Mode	Verdict
CDMA Cellular Band	Pass
CDMA PCS Band	Pass
CDMA AWS Band	Pass

5.2.4 Signal Quality

Cell Phone Mode	Minimum Limit [dB]				Minimum Result [dB]	Category	Note
	T1	T2	T3	T4			
CDMA Cellular Band	0 to 10	10 to 20	20 to 30	>30	38.90	T4	-
CDMA PCS Band	0 to 10	10 to 20	20 to 30	>30	39.80	T4	-
CDMA AWS Band	0 to 10	10 to 20	20 to 30	>30	38.60	T4	-

Appendix A - Measurement Scans

Test Laboratory: A Test Lab Techno Corp.

Date/Time: 8/12/2010 7:37:20 PM

T-Coil_CDMA Cellular CH384_x (longitudinal)

DUT: HUAWEI C8600/HUAWEI M860; Type: Mobile phone; FCC ID: QISM860

Communication System: CDMA Cellular ; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: AM1DV2 - 1017; ; Calibrated: 2/23/2010
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn779; Calibrated: 1/21/2010
- Phantom: HAC Test Arch with Coil; Type: SD_HAC_P02_AB; Serial: 1011
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.2 Build 87

Coarse Scans/x (axial) scan 50 x 50 (grid 10) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -10.3 dB A/m
BWC Factor = 0.152993 dB
Location: -5, 5, 363.7 mm

Fine scan/x (longitudinal) scan 10 x 10 (grid 2) with noise 2/ABM Signal(x,y,z) (6x6x1)
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -7.97 dB A/m
BWC Factor = 0.152993 dB
Location: -8, 0, 363.7 mm

Point scan/x (longitudinal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 38.9 dB
ABM1 comp = -9.23 dB A/m
BWC Factor = 0.152993 dB
Location: -8, 0, 363.7 mm

Point scan/x (longitudinal) scan at point with noise/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -9.23 dB A/m
BWC Factor = 0.152993 dB
Location: -8, 0, 363.7 mm

Test Laboratory: A Test Lab Techno Corp.

Date/Time: 8/12/2010 7:38:53 PM

T-Coil_CDMA Cellular CH384_y (transversal)

DUT: HUAWEI C8600/HUAWEI M860; Type: Mobile phone; FCC ID: QISM860

Communication System: CDMA Cellular ; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: AM1DV2 - 1017; ; Calibrated: 2/23/2010
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn779; Calibrated: 1/21/2010
- Phantom: HAC Test Arch with Coil; Type: SD_HAC_P02_AB; Serial: 1011
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.2 Build 87

Coarse Scans/y (axial) scan 50 x 50 (grid 10) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.95 dB A/m
BWC Factor = 0.152993 dB
Location: 5, -5, 363.7 mm

Fine scan/y (transversal) scan 10 x 10 (grid 2) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.35 dB A/m
BWC Factor = 0.152993 dB
Location: 2, -6, 363.7 mm

Point scan/y (transversal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 39.9 dB
ABM1 comp = -8.25 dB A/m
BWC Factor = 0.152993 dB
Location: 2, -6, 363.7 mm

Point scan/y (transversal) scan at point with noise/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.25 dB A/m
BWC Factor = 0.152993 dB
Location: 2, -6, 363.7 mm

Test Laboratory: A Test Lab Techno Corp.

Date/Time: 8/12/2010 7:35:43 PM

T-Coil_CDMA Cellular CH384_z (axial)

DUT: HUAWEI C8600/HUAWEI M860; Type: Mobile phone; FCC ID: QISM860

Communication System: CDMA Cellular ; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: AM1DV2 - 1017; ; Calibrated: 2/23/2010
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn779; Calibrated: 1/21/2010
- Phantom: HAC Test Arch with Coil; Type: SD_HAC_P02_AB; Serial: 1011
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.2 Build 87

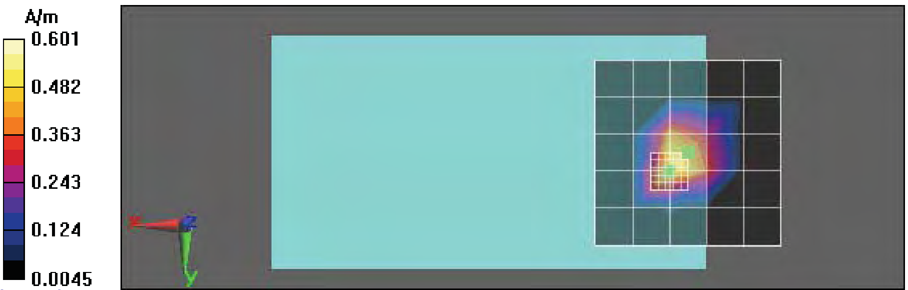
Coarse Scans/z (axial) scan 50 x 50 (grid 10) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -4.42 dB A/m
BWC Factor = 0.152993 dB
Location: 5, 5, 363.7 mm

Fine scan/z (axial) scan 10 x 10 (grid 2) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = 0.372 dB A/m
BWC Factor = 0.152993 dB
Location: 0, 0, 363.7 mm

Point scan/z (axial) 300-3k response at max/ABM Freq Resp(x,y,z,f) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
Diff = 1.94 dB
BWC Factor = 10.8 dB
Location: 0, 0, 363.7 mm

Point scan/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 45.6 dB
ABM1 comp = -2.69 dB A/m
BWC Factor = 0.152993 dB
Location: 0, 0, 363.7 mm

Point scan/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -2.69 dB A/m
BWC Factor = 0.152993 dB
Location: 0, 0, 363.7 mm



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 8/12/2010 8:05:43 PM

T-Coil_CDMA PCS CH600_x (longitudinal)

DUT: HUAWEI C8600/HUAWEI M860; Type: Mobile phone; FCC ID: QISM860

Communication System: CDMA PCS ; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: AM1DV2 - 1017; ; Calibrated: 2/23/2010
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn779; Calibrated: 1/21/2010
- Phantom: HAC Test Arch with Coil; Type: SD_HAC_P02_AB; Serial: 1011
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.2 Build 87

Coarse Scans/x (axial) scan 50 x 50 (grid 10) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -10.3 dB A/m
BWC Factor = 0.152993 dB
Location: -5, 5, 363.7 mm

Fine scan/x (longitudinal) scan 10 x 10 (grid 2) with noise 2/ABM Signal(x,y,z) (6x6x1)
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.7 dB A/m
BWC Factor = 0.152993 dB
Location: -8, 2, 363.7 mm

Point scan/x (longitudinal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 39.8 dB
ABM1 comp = -8.75 dB A/m
BWC Factor = 0.152993 dB
Location: -8, 2, 363.7 mm

Point scan/x (longitudinal) scan at point with noise/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.75 dB A/m
BWC Factor = 0.152993 dB
Location: -8, 2, 363.7 mm

Test Laboratory: A Test Lab Techno Corp.

Date/Time: 8/12/2010 8:07:16 PM

T-Coil_CDMA PCS CH600_y (transversal)

DUT: HUAWEI C8600/HUAWEI M860; Type: Mobile phone; FCC ID: QISM860

Communication System: CDMA PCS ; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3
Phantom section: AMB with Coil Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: AM1DV2 - 1017; ; Calibrated: 2/23/2010
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn779; Calibrated: 1/21/2010
- Phantom: HAC Test Arch with Coil; Type: SD_HAC_P02_AB; Serial: 1011
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.2 Build 87

Coarse Scans/y (axial) scan 50 x 50 (grid 10) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -10.1 dB A/m
BWC Factor = 0.152993 dB
Location: 5, -5, 363.7 mm

Fine scan/y (transversal) scan 10 x 10 (grid 2) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.55 dB A/m
BWC Factor = 0.152993 dB
Location: 2, -4, 363.7 mm

Point scan/y (transversal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 40 dB
ABM1 comp = -8.26 dB A/m
BWC Factor = 0.152993 dB
Location: 2, -4, 363.7 mm

Point scan/y (transversal) scan at point with noise/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.26 dB A/m
BWC Factor = 0.152993 dB
Location: 2, -4, 363.7 mm

Test Laboratory: A Test Lab Techno Corp.

Date/Time: 8/12/2010 8:04:06 PM

T-Coil_CDMA PCS CH600_z (axial)

DUT: HUAWEI C8600/HUAWEI M860; Type: Mobile phone; FCC ID: QISM860

Communication System: CDMA PCS ; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3
Phantom section: AMB with Coil Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: AM1DV2 - 1017; ; Calibrated: 2/23/2010
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn779; Calibrated: 1/21/2010
- Phantom: HAC Test Arch with Coil; Type: SD_HAC_P02_AB; Serial: 1011
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.2 Build 87

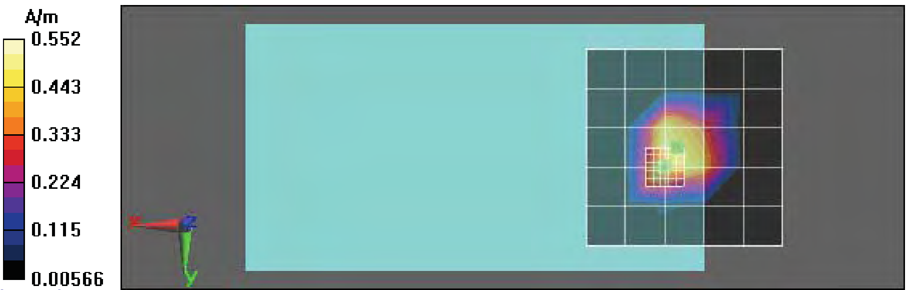
Coarse Scans/z (axial) scan 50 x 50 (grid 10) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -5.16 dB A/m
BWC Factor = 0.152993 dB
Location: 5, 5, 363.7 mm

Fine scan/z (axial) scan 10 x 10 (grid 2) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = 0.723 dB A/m
BWC Factor = 0.152993 dB
Location: 2, 0, 363.7 mm

Point scan/z (axial) 300-3k response at max/ABM Freq Resp(x,y,z,f) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
Diff = 0.481 dB
BWC Factor = 10.8 dB
Location: 2, 0, 363.7 mm

Point scan/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 48.7 dB
ABM1 comp = -0.011 dB A/m
BWC Factor = 0.152993 dB
Location: 2, 0, 363.7 mm

Point scan/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -0.011 dB A/m
BWC Factor = 0.152993 dB
Location: 2, 0, 363.7 mm



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 8/12/2010 8:41:45 PM

T-Coil_CDMA AWS CH450_x (longitudinal)

DUT: HUAWEI C8600/HUAWEI M860; Type: Mobile phone; FCC ID: QISM860

Communication System: CDMA AWS; Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: AM1DV2 - 1017; ; Calibrated: 2/23/2010
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn779; Calibrated: 1/21/2010
- Phantom: HAC Test Arch with Coil; Type: SD_HAC_P02_AB; Serial: 1011
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.2 Build 87

Coarse Scans/x (axial) scan 50 x 50 (grid 10) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -10.4 dB A/m
BWC Factor = 0.152993 dB
Location: -5, 5, 363.7 mm

Fine scan/x (longitudinal) scan 10 x 10 (grid 2) with noise 2/ABM Signal(x,y,z) (6x6x1)
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.23 dB A/m
BWC Factor = 0.152993 dB
Location: -6, 0, 363.7 mm

Point scan/x (longitudinal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 38.6 dB
ABM1 comp = -9.09 dB A/m
BWC Factor = 0.154017 dB
Location: -6, 0, 363.7 mm

Point scan/x (longitudinal) scan at point with noise/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -9.09 dB A/m
BWC Factor = 0.154017 dB
Location: -6, 0, 363.7 mm

Test Laboratory: A Test Lab Techno Corp.

Date/Time: 8/12/2010 8:43:18 PM

T-Coil_CDMA AWS CH450_y (transversal)

DUT: HUAWEI C8600/HUAWEI M860; Type: Mobile phone; FCC ID: QISM860

Communication System: CDMA AWS; Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: AM1DV2 - 1017; ; Calibrated: 2/23/2010
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn779; Calibrated: 1/21/2010
- Phantom: HAC Test Arch with Coil; Type: SD_HAC_P02_AB; Serial: 1011
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.2 Build 87

Coarse Scans/y (axial) scan 50 x 50 (grid 10) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -9.82 dB A/m
BWC Factor = 0.152993 dB
Location: 5, -5, 363.7 mm

Fine scan/y (transversal) scan 10 x 10 (grid 2) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -7.32 dB A/m
BWC Factor = 0.152993 dB
Location: 2, -6, 363.7 mm

Point scan/y (transversal) scan at point with noise/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 40.3 dB
ABM1 comp = -8.2 dB A/m
BWC Factor = 0.154017 dB
Location: 2, -6, 363.7 mm

Point scan/y (transversal) scan at point with noise/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.2 dB A/m
BWC Factor = 0.154017 dB
Location: 2, -6, 363.7 mm

Test Laboratory: A Test Lab Techno Corp.

Date/Time: 8/12/2010 8:40:08 PM

T-Coil_CDMA AWS CH450_z (axial)

DUT: HUAWEI C8600/HUAWEI M860; Type: Mobile phone; FCC ID: QISM860

Communication System: CDMA AWS; Frequency: 1732.5 MHz;Duty Cycle: 1:1
Medium parameters used: σ = 0 mho/m, $\varepsilon_r = 1$; ρ = 1 kg/m^3
Phantom section: AMB with Coil Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: AM1DV2 - 1017; ; Calibrated: 2/23/2010
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn779; Calibrated: 1/21/2010
- Phantom: HAC Test Arch with Coil; Type: SD_HAC_P02_AB; Serial: 1011
- Measurement SW: DASY5, V5.0 Build 125;SEMCAD X Version 13.2 Build 87

Coarse Scans/z (axial) scan 50 x 50 (grid 10) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -4.01 dB A/m
BWC Factor = 0.152993 dB
Location: 5, 5, 363.7 mm

Fine scan/z (axial) scan 10 x 10 (grid 2) with noise/ABM Signal(x,y,z) (6x6x1):
Measurement grid: dx=10mm, dy=10mm

Cursor:
ABM1 comp = 0.201 dB A/m
BWC Factor = 0.152993 dB
Location: 2, 0, 363.7 mm

Point scan/z (axial) 300-3k response at max/ABM Freq Resp(x,y,z,f) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
Diff = 1.72 dB
BWC Factor = 10.8 dB
Location: 2, 0, 363.7 mm

Point scan/z (axial) scan at point with noise/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 49.7 dB
ABM1 comp = 0.434 dB A/m
BWC Factor = 0.154017 dB
Location: 2, 0, 363.7 mm

Point scan/z (axial) scan at point with noise/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = 0.434 dB A/m
BWC Factor = 0.154017 dB
Location: 2, 0, 363.7 mm

Appendix B - Measurement Uncertainty

Error Description	Uncertainty value[%]	Prob. Dist.	Div.	c ABM1	c ABM2	Std. Unc. ABM1	Std. Unc. ABM2
PROBE SENSITIVITY							
Reference level	3.0	N	1.0	1	1	3.0	3.0
AMCC geometry	0.4	R	1.7	1	1	0.2	0.2
AMCC current	0.6	R	1.7	1	1	0.4	0.4
Probe positioning during calibration	1.0	R	1.7	1	1	0.6	0.6
Noise contribution	0.7	R	1.7	0.014	1	0.0	0.4
Frequency slope	5.9	R	1.7	0.1	1.0	0.3	3.5
PROBE SYSTEM							
Repeatability / Drift	1.0	R	1.7	1	1	0.6	0.6
Linearity / Dynamic range	0.6	R	1.7	1	1	0.4	0.4
Acoustic noise	1.0	R	1.7	0.1	1	0.1	0.6
Probe angle	2.3	R	1.7	1	1	1.4	1.4
Spectral processing	0.9	R	1.7	1	1	0.5	0.5
Integration time	0.6	N	1.0	1	5	0.6	3.0
Field disturbation	0.2	R	1.7	1	1	0.1	0.1
TESTT SIGNAL							
Reference signal spectral response	0.6	R	1.7	0	1	0.0	0.4
POSITIONING							
Probe positioning	1.9	R	1.7	1	1	1.1	1.1
Phantom thickness	0.9	R	1.7	1	1	0.5	0.5
DUT positioning	1.9	R	1.7	1	1	1.1	1.1
EXTERNAL CONTRIBUTIONS							
RF interference	0.0	R	1.7	1	1	0.0	0.0
Test signal variation	2.0	R	1.7	1	1	1.2	1.2
COMBINED UNCERTAINTY							
Combined td. Uncertainty (ABM field)						4.1	6.2
Expanded Std. Uncertainty [%]						8.2	12.3

Table 2. Draft T-Coil Uncertainty Budget, provided by SPEAG Jun. 07, 2006

Appendix C - Calibration

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

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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 **ATL (Auden)**

Certificate No: **DAE4-779_Jan10**

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BJ - SN: 779
Calibration procedure(s)	QA CAL-06.v12 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	January 21, 2010

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	1-Oct-09 (No: 9055)	Oct-10
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Calibrator Box V1.1	SE UMS 006 AB 1004	05-Jun-09 (in house check)	In house check: Jun-10

	Name	Function	Signature
Calibrated by:	Andrea Guntli	Technician	[signature]
Approved by:	Fin Bomholt	R&D Director	i.V. [signature]

Issued: January 21, 2010

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Certificate No: DAE4-779_Jan10 Page 1 of 5

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Accreditation No.: **SCS 108**

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.487 ± 0.1% (k=2)	403.723 ± 0.1% (k=2)	403.948 ± 0.1% (k=2)
Low Range	3.97046 ± 0.7% (k=2)	3.98719 ± 0.7% (k=2)	4.00014 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	84.5 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200010.5	1.14	0.00
Channel X	+ Input	20003.28	3.68	0.02
Channel X	- Input	-19997.24	3.06	-0.02
Channel Y	+ Input	200009.6	0.87	0.00
Channel Y	+ Input	19999.83	0.43	0.00
Channel Y	- Input	-19998.10	2.10	-0.01
Channel Z	+ Input	199998.4	0.15	0.00
Channel Z	+ Input	20000.44	1.04	0.01
Channel Z	- Input	-19997.62	-0.01	-0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	1999.6	-0.33	-0.02
Channel X	+ Input	199.84	-0.16	-0.08
Channel X	- Input	-200.02	-0.22	0.11
Channel Y	+ Input	2000.1	0.05	0.00
Channel Y	+ Input	198.87	-1.13	-0.56
Channel Y	- Input	-201.72	-1.62	0.81
Channel Z	+ Input	2000.2	0.14	0.01
Channel Z	+ Input	199.12	-1.18	-0.59
Channel Z	- Input	-200.60	-0.60	0.30

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-3.75	-5.42
	- 200	6.52	4.96
Channel Y	200	14.47	13.94
	- 200	-14.47	-14.52
Channel Z	200	3.70	3.28
	- 200	-3.73	-3.84

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	2.60	0.09
Channel Y	200	1.31	-	3.04
Channel Z	200	2.43	-2.04	-

4. **AD-Converter Values with inputs shorted**

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15621	15863
Channel Y	15831	16095
Channel Z	16132	15816

5. **Input Offset Measurement**

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	-0.14	-1.27	1.10	0.43
Channel Y	-0.91	-2.36	0.81	0.61
Channel Z	-1.02	-1.92	0.28	0.44

6. **Input Offset Current**

Nominal Input circuitry offset current on all channels: <25fA

7. **Input Resistance**

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.1999	202.7
Channel Y	0.1999	202.5
Channel Z	0.2000	202.7

8. **Low Battery Alarm Voltage** (verified during pre test)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. **Power Consumption** (verified during pre test)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.0	+6	+14
Supply (- Vcc)	−0.01	-8	-9

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **ATL (Auden)**

Certificate No: **AM1DV2-1017_Feb10**

CALIBRATION CERTIFICATE

Object	AM1DV2 - SN: 1017
Calibration procedure(s)	QA CAL-24.v2 Calibration procedure for AM1D magnetic field probes and TMFS in the audio range
Calibration date:	February 23, 2010

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	1-Oct-09 (No: 9055)	Oct-10
Reference Probe AM1DV2	SN: 1008	21-Jan-10 (No. AM1D-1008_Jan10)	Jan-11
DAE4	SN: 781	22-Jan-10 (No. DAE4-781_Jan10)	Jan-11

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

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

Issued: February 25, 2010

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] DASY4 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	**AM1DV2** Audio Magnetic 1D Field Probe
Type No	SP AM1 001 AD
Serial No	**1017**

Overall length	296 mm
Tip diameter	6.0 mm (at the tip)
Sensor offset	3.0 mm (centre of sensor from tip)
Internal Amplifier	40 dB

Manufacturer / Origin	Schmid & Partner Engineering AG, Zurich, Switzerland
Manufacturing date	Apr-2006
Last calibration date	March 12, 2009

Calibration data

Connector rotation angle	(in DASY system)	**231.9 °**	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	**-0.16 °**	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	**0.0650 V / (A/m)**	+/- 2.2 % (k=2)