MOTOROLA

FCC ID: IHDP56NB1

DECLARATION OF COMPLIANCE HAC ASSESSMENT - TELECOIL

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Date of Report: **10 Jan 2013**
Report Revision: **Rev. 0**
Report ID: **FCC_HAC_Telecoil_Rpt_i460_Rev-O_130110**

Responsible Engineer:	Lee Chee Hoong
Date/s Tested:	01/10/2013
Manufacturer/Location:	Motorola – Plantation, Florida
Sector/Group/Div.:	iDEN Mobile Devices
Date submitted for test:	10 Jan 2013
DUT Description:	iDEN Clamshell Handset with Internal Antenna
Signaling type:	TDMA: iDEN
Test TX mode(s):	2:6 (a.k.a. 1:3), 1:6
Max. Power output:	0.640 W; Pulse Average; Factory tuning
Nominal Power:	0.600 W; Pulse Average; Factory tuning
TX Frequency Bands:	iDEN - 806-825 MHz
Model(s) Tested:	i460 (H3060241031A)
Model(s) Certified:	i460 (H3060241031A)
Serial Number(s):	364BNY19MS
Rule Part(s):	20.19(b)(2)

Approved Applicable Accessories:

Antenna(s):

85014296001 Monopole ¼ wave antenna
TX 806-825 MHz, RX 851-870MHz

Battery(ies):

SNN5898A BP6X High Performance Li-Ion Battery Battery Cover – NTN3047MOTA

Min. Axial field strength: **-0.69 dB A/m**
Min. Radial field strength: **-9.70 dB A/m**
Min. ABM Desired-to-Undesired signal ratio: **38.33 dB**
HAC Category rating: **T4**

John Lewczak
Motorola Mobility, Inc.

/s/ John Lewczak **Approval Date:** 15 January 2013

Certification Date: 15 January 2013

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REVISION HISTORY

Date	Revision	Comments
1/15/2013	O	Initial release.

1.0 Introduction and Overview

This report details the utilization, test setup, test equipment, and test results of Hearing Aid Compatibility (HAC) telecoil measurements required per 47 CFR 20.19(b)(2). These measurements were performed during a controlled on-network telephone call at full rated RF power with the antenna extended to assess compliance with the ANSI C63.19-2007 standard. The data in this report are for assessing T-coil compliance only.

Per the Table 7-1 of the standard the iDEN air interface protocol articulation weighting factor (AWF) has been assigned a value of zero.

2.0 Telecoil Compliance Criteria (Per ANSI C63.19-2007; section 7.3)

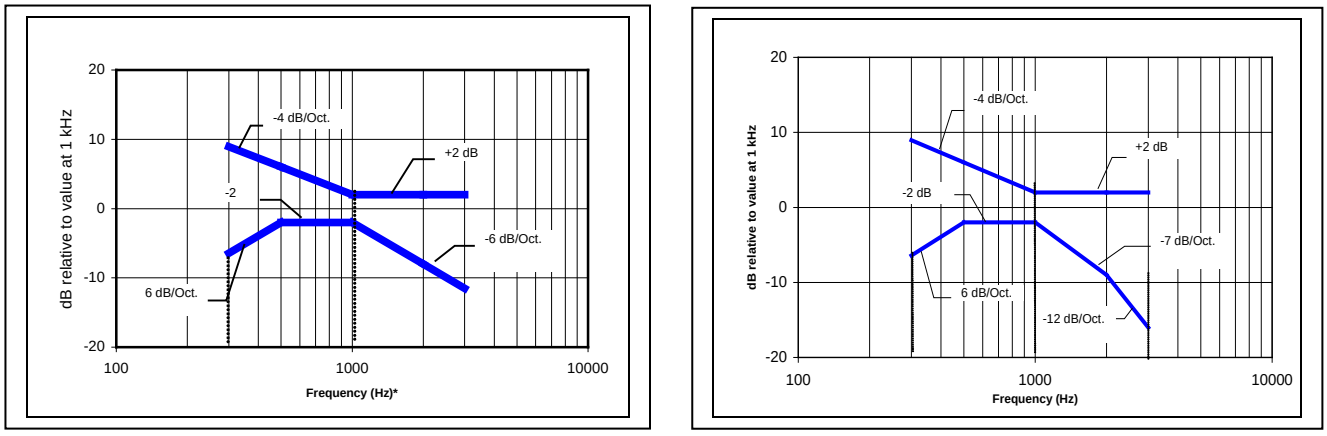
The signal quality rating shall be T4 or better per 47 CFR 20.19. Per ANSI C63.19-2007 this rating is dependent upon the articulation weighting factor (AWF) for specific air interface protocols as listed in the following table:

Table 2-1 – Signal Quality rating limits

Rating	AWF = 0
T4	> 30 dB
T3	20 to 30 dB

To merit this rating the axial component and the radial components of the audio band magnetic (ABM) field shall be ≥ -18 dB A/m at 1 kHz.

In addition the frequency response shall lie with the limit lines evident in the following graphs:



A – Mask for WDs with a field <= -15 dB(A/m) at 1 kHz B - Mask for WDs with a field that exceeds -15 dB (A/m) at 1kHz

Figure 1-1 –Frequency Response (Axial only)

The current ANSI C63.19-2007 methodology used to determine a wireless device (WD) T-category rating is illustrated in the attached flow chart in Figure 2-2. This process presumes that the interference heard by a hearing aid used is dominated by the RF interference component rather than the inductively coupled noise interference component due to pulsing currents flowing in a handset. As a result a WD T-category rating value is precluded from exceeding the RF interference rating by virtue of the highlighted steps within the diagram.

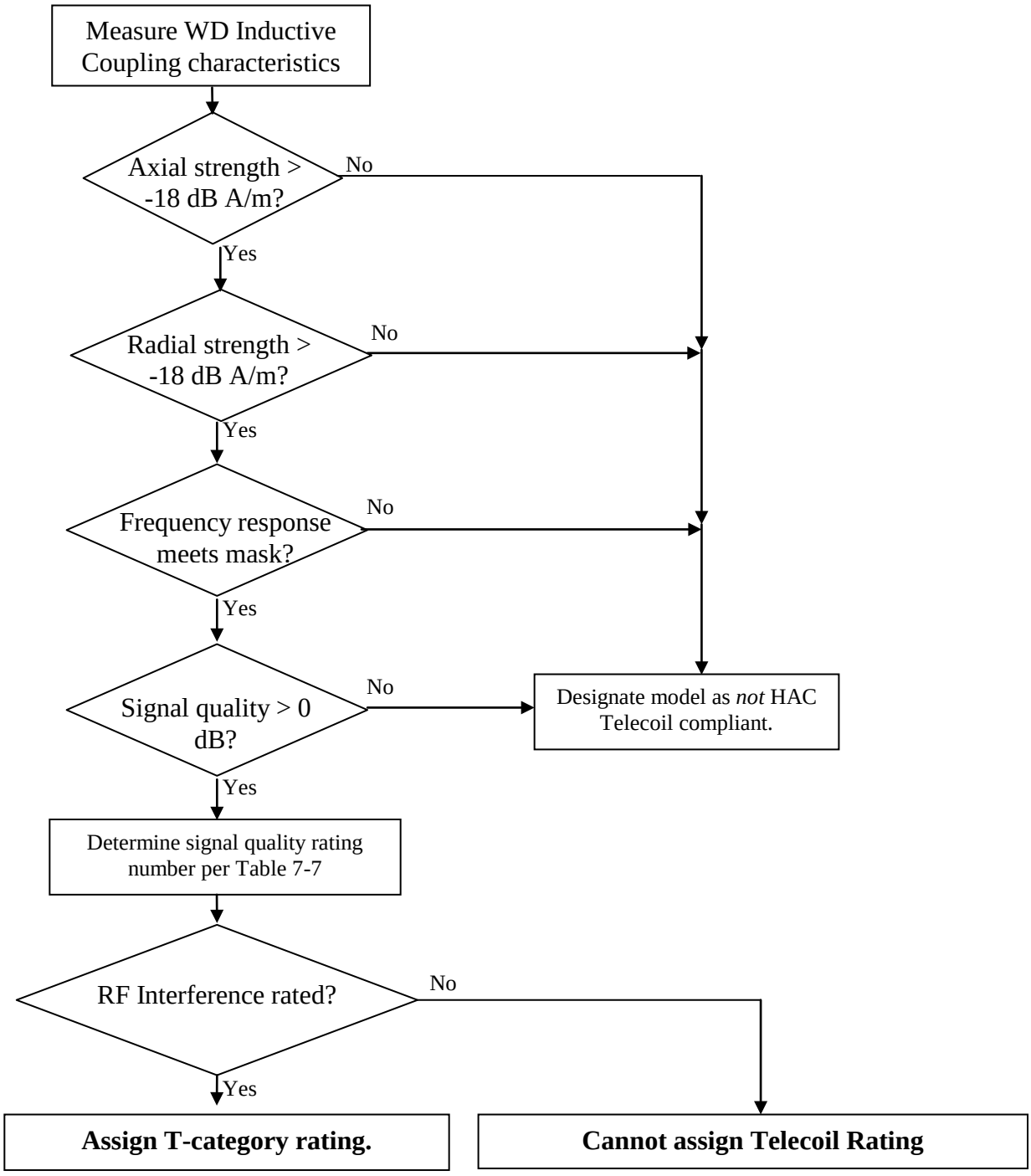


Figure 2-2 - WD Telecoil Category Rating Process
(Note: RFI rating assumed to be M3 or M4)

3.0 Description of Device Under Test (DUT)

3.1 General Description of UUT.

FCC ID: IHDT56NB1 is used for telephone service subject to 47 CFR 20.19 for hearing aid compatibility. The maximum output power is 0.640 watts pulse average as determined by the upper limit of the production line final test station. The DUT was tuned to be within 5% of the maximum rated power. It is capable of transmitting on any network commanded frequency in the bands of 806 to 821 MHz (within the United States). It employs a time division multiplexing (TDM) transmission technology with a duty cycle of 16.67% (1:6 multiplexing) or 33.33% (2:6 multiplexing) using 16-QAM modulation on each of four OFDM-like sub-carriers. Since the TDM period is fixed at 90 ms. this duty cycle difference results in a difference in the RF carrier modulation envelope fundamental frequency being either 11 Hz or 22 Hz respectively. To evaluate the effect of the difference in envelope fundamental frequency measurements were made with both duty cycles in each band of operation (see section 9).

A different Vocoder is used for each multiplexing factor as commanded by the cellular network because a more efficient Vocoder is needed to achieve the greater spectral efficiency provided by the low-rate 1:6 multiplexing. Each Vocoder operates for the full duration of a transmission burst and both produce a random digital stream during the burst so between them there is essentially no difference in the modulation envelope during the burst. Accordingly measurements were made for the 2 duty cycles using the Vocoder normally used with the particular duty cycle.

User controls include selecting the duration of the backlight duration and the audio frequency response characteristic. Once set, these characteristics are maintained until the user adjusts them. Instructions for setting the backlight duration and the frequency response are provided in the User Guide respectively in the sections entitled Customizing Your Phone, User Settings, and Advanced Calling Features, Features for the Hearing Impaired.

3.2 Summary of Concurrency of Operating Modes.

Air Interface	Band (MHz)	Type	C63.19 Tested	Simultaneous Transmission[1]	Concurrent Single Transmission	Reduced Power 20.19 (c)(1)[2]	Voice Over Digital Transport (Data)
iDEN	800	VO	Yes	Yes (Bluetooth)	No	NA	NA
	Packet Data	DT	NA	NA	NA	NA	No

VO: Voice CMRS/PSTN Service Only

V/D: Voice CMRS/PSTN and Data Service

DT: Digital Transport (Data).

[1] Not to be tested.

[2] 2010 Order permits a user-selectable mode that reduces power up to 2.5 dB for 1900 MHz GSM *only*.

[3] HAC Rating was not based on concurrent voice and data modes. Non-concurrent mode was found to represent the equivalent worst case for both M and T ratings.

4.0 Test Equipment List

Table 4-1 – List of test equipment used

Equipment Type	Model Number	Serial Number	Calibration Due
T-HAC Probe	AM1DV2	1033	10-19-12
Audio Analyzer software	DASY4		Not Required
Audio Interface	AMMI	1031	Part of System Calibration
Helmholtz Calibration Coil	AMCC	1028	Part of System Calibration
Telephone Magnetic Field Simulator	TMFS-1	1007	10-22-12

5.0 Descriptions of Measurement System (a variation of ANSI C63.19-2007; Figure 6-1)

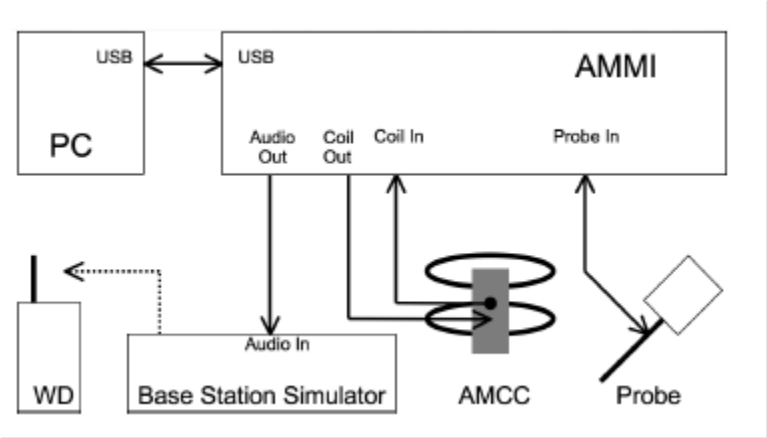


Figure 5-1 – Test System Configuration

The laboratory utilizes DASY 4 HAC T-Coil measurement system, which is an extension to DASY4 system with the capability of Audio Band Magnetic (ABM) measurements according to standard ANSI-C63.19-2007. Using DASY4, three orthogonal axes are scanned with a probe incorporating a single sensor coil: one axial (perpendicular) and two radial (transverse and longitudinal) directions with respect to the plane and main axis of the Wireless Device (WD).

6.0 Measurement System Verification

The HAC measurements were conducted with T-Coil probes model/serial number AM1DV2/1033. A Telephone Magnetic Field Simulator (TMFS) was used (rather than a Helmholtz coil) for system verification following the guidelines stated in the TMFS procedures document. For calibration, telecoil probe output signal levers were compared with target valued provided by the manufacturer, and the results provided in Table 6-1-1. The photos below depict the validation setup using the TMFS.

Figure 6-1 – Probe coil being calibrated with TMFS

6.1 System Verification Test Results

In accordance with ANSI C63.19-2007, clause 6.2.4 the probes were calibrated and sensitivity levels at 1 kHz verified and listed below on 9 December 2012. System verification measurement results for Axial and Radial probes are listed and compared with expected values from the TMFS in Table 6-1-1. The data demonstrates compliance to the ± 0.5 dB tolerance.

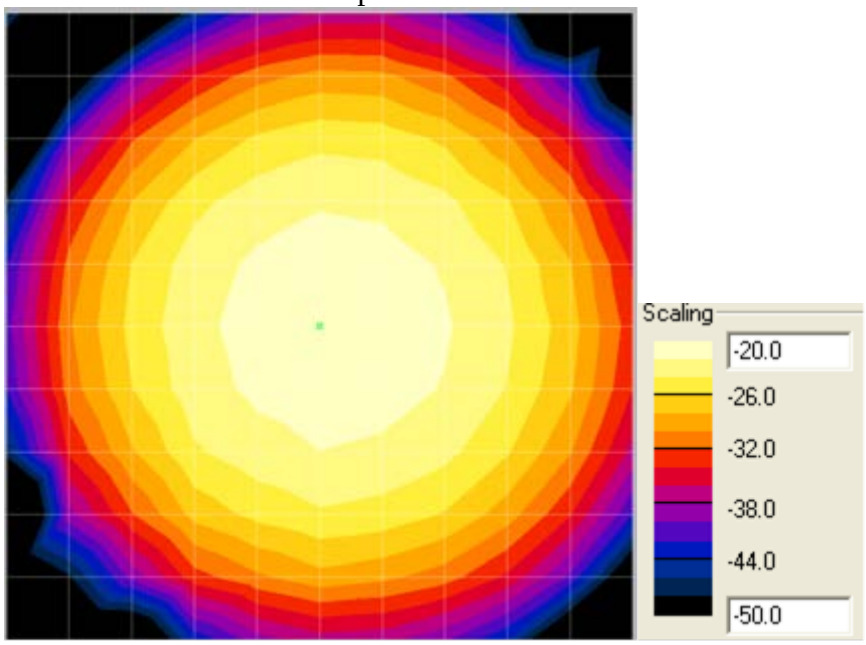


Figure 6-1-1 - Axial Probe Field Plot

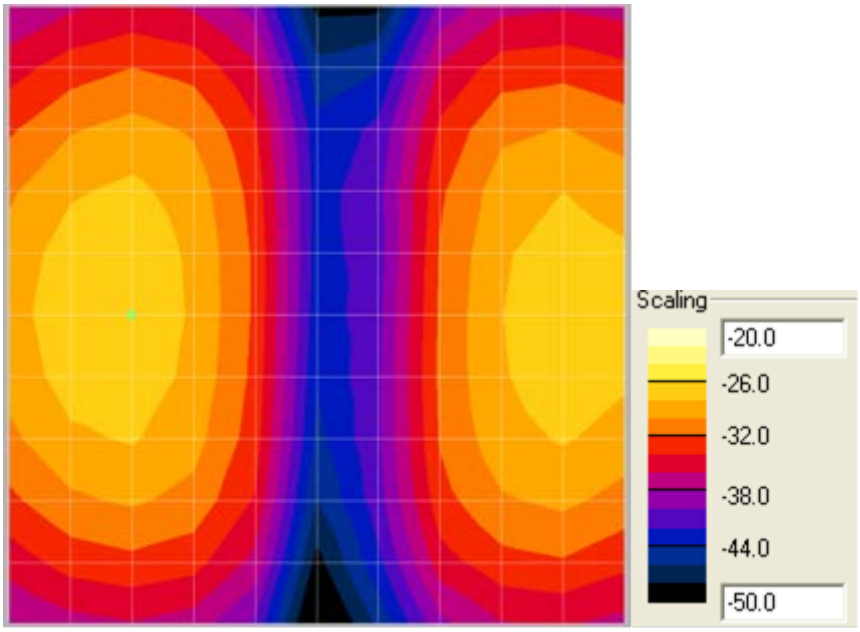


Figure 6-1-2 - Radial 1 Probe Field Plot

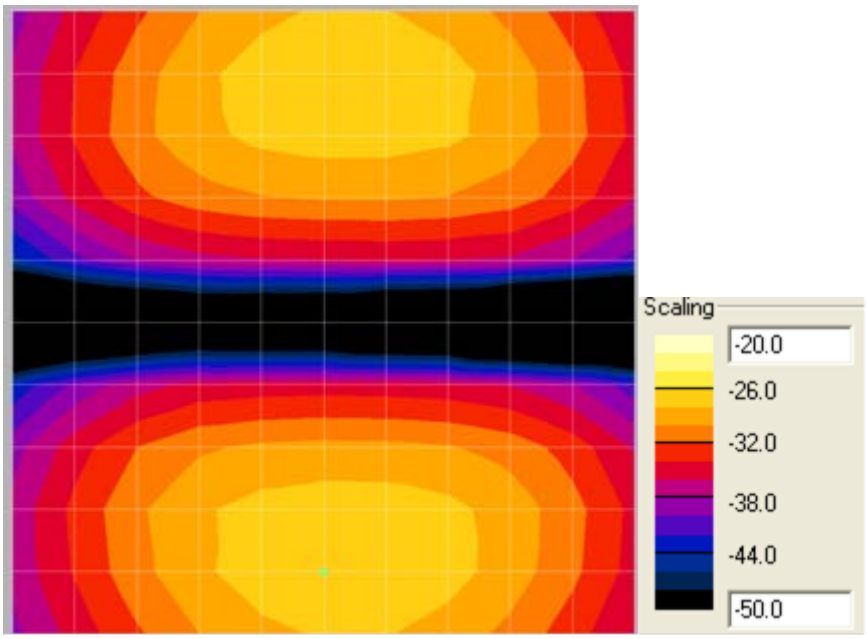


Figure 6-1-3 - Radial 2 Probe Field Plot

Table 6-1-1 - Probe Sensitivity

Orientation	Input Signal	Target Magnetic Field	Measured Magnetic field	Deviation
Axial	1 kHz, 0.5V	-20.35 dB A/m	-20.79 dB A/m	0.44 dB
Radial 1	1 kHz, 0.5V	-26.05 dB A/m	-26.41 dB A/m	0.36 dB
Radial 2	1 kHz, 0.5V	-25.95 dB A/m	-26.33 dB A/m	0.38 dB

6.2 RF Immunity Verification

To alleviate any concern that RF radiation from the handset would influence ABM readings by the measurement system the ambient noise floor was measured when a Reference Coil was positioned where the handset antenna was located during ABM measurements. The Plots below show the Axial probe ambient noise floor measured with and without RF. The RF signal was produced with a signal generator at 900 and 1900 MHz transmitting at a power level of 1 Watt. The data shows only a small affect to the frequency response below 300 Hz, the amount of which would be negligible in the determination of the signal quality.

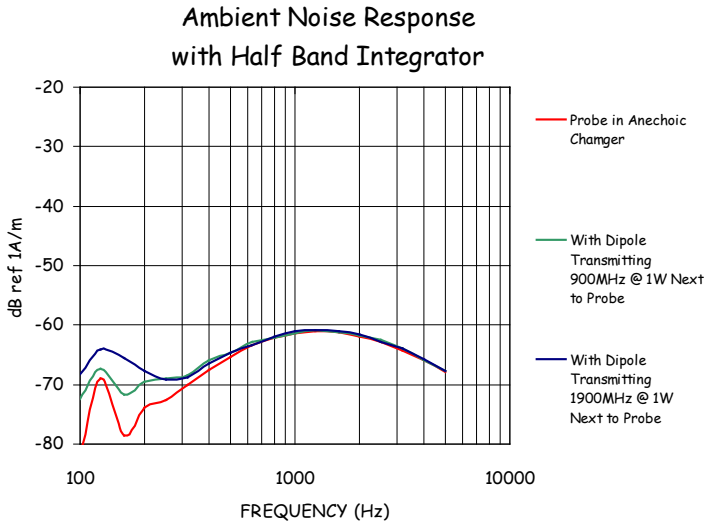


Figure 6-2 – Noise with RF Measured Response

6.3 RF Frequency Independence

Additional set of ABM data was taken to verify that the ABM data was not dependent on the RF test frequency. The commercially available R2660B Service Monitor instrument was used to obtain additional ABM1 and ABM 2 axial orientation data at several band-edge and mid-band frequencies to verify that the ABM data is independent of the test frequency. The data is listed in the following table together with some statistical results that show ABM data is essentially independent of the RF test frequency.

Table 6.3 –Axial Probe Measurements

Axial		
Test Frequency (MHz)	**AMB1 (dB A/m)**	**AMB2 (dB A/m)**
806.1000 MHz	18.07	-49.21
813.5125 MHz	18.01	-48.28
820.9875 MHz	17.95	-49.28
Standard Deviation	**0.06**	**0.56**

7.0 DUT Setup and Test Procedure

The test setup was done as specified in ANSI C63.19-2007, section 6.3.2 and Figure 6-1. Axial and radial measurements were performed at locations in accordance with ANSI C63.19-2007; Annex A.3, and are illustrated in the test setup photograph. The coordinates for these locations, relative to the acoustic output center, are given in Table 7. The test flow and procedure was per ANSI C63.19-2007, Figure 6-3, and section 6.3.1 was followed in order to demonstrate compliance. The test procedure consisted of placing the DUT in an interconnect phone call from the Sprint-Nextel system to a phone on the Motorola test site. Transmission power was monitored via embedded diagnostic software that displays output power to ensure no power cutback occurred. Then from the Motorola Audio Lab connection to the Mobile Switch Center (MSC) on the Motorola test site an 11 second P50 male signal was sent to the DUT. The P50 artificial speech levels were determined by the reference input levels as stated in ANSI C63.19-2007, Table 6-1.

iDEN TDMA (22 and 11 Hz): -18 dBm0

Below is the corresponding voltage level used to send the audio signal to the iDEN network:

Input Level to the iDEN Network: -20.7 dB V = 92.26mV

The signal was then measured with the telecoil and analyzed for frequency response and level. The test results were obtained with:

- The DUT user interface configured for telecoil operation,
- The display and keypad lighting off as would normally be the case when used for a call.
- The probe manually positioned for maximum coupling, then secured (See coordinates in Table 7):
    - Axial - center of acoustic output.
    - Radial 1 - probe at 0 degrees just left of the acoustic output center.
    - Radial 2 - probe at 90 degrees just above the acoustic output center.

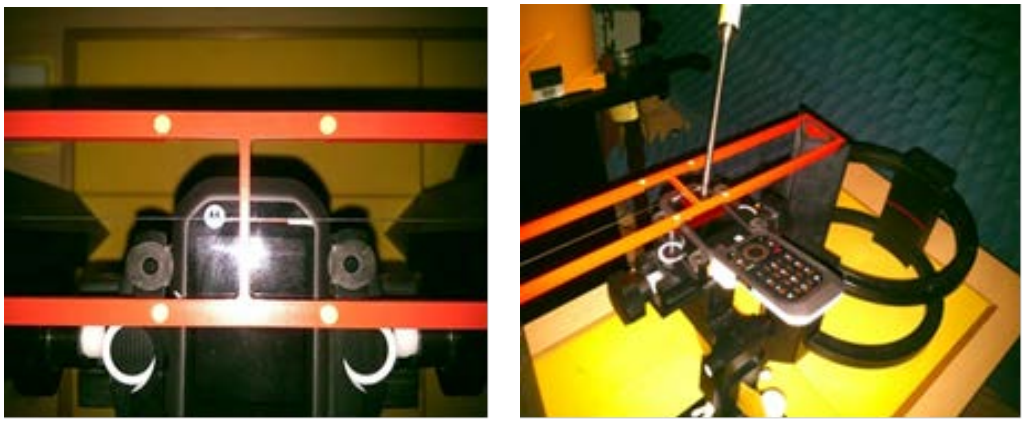


Figure 7-1 – Test holder

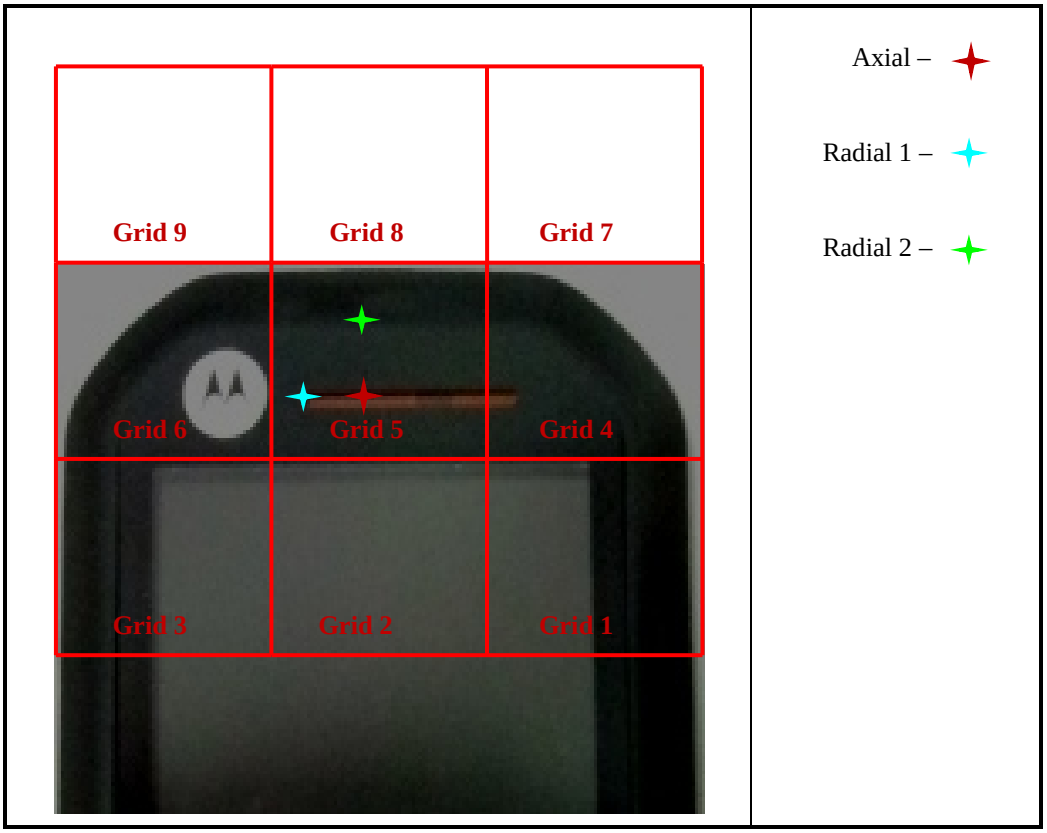


Figure 7-2 – Measurement location coordinates

Table 7 – Measurement location coordinates

Location	X coordinate (mm)	Y coordinate (mm)	Sub-grid Number (See Appendix A)
Axial -	-2.7	-2.8	5
Radial 1 -	-10.7	0	5
Radial 2 -	-2.7	5.2	5

Note: X is offset to the right from the center of the acoustic output and Y is the vertical offset (see Figure A-5 in ANSI C63.19-2007).

8.0 Environmental Test Conditions

The table below presents the range and average environmental conditions during the HAC tests reported herein:

Table 8 – Environmental Conditions

	Target	Measured
Ambient Temperature	23 ˚C +/- 5 ˚C	Within Guidelines
Relative Humidity	0 - 80 %	Within Guidelines

The audio lab ambient and test system noise level was determined and found satisfactory as specified in ANSI C63.19-2007, section 6.2.1. The following graph shows the results obtained using a 1/3rd octave resolution bandwidth filter.

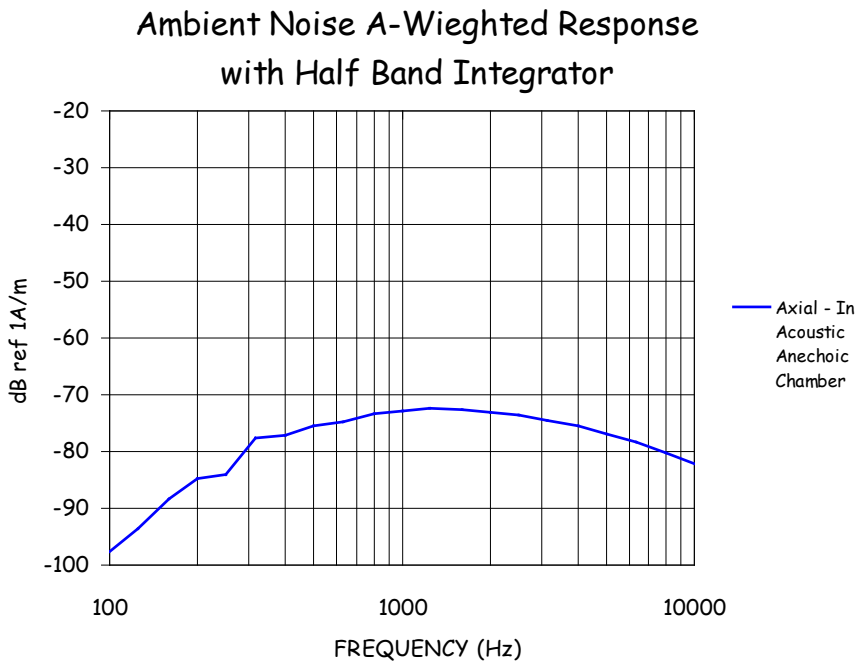


Figure 8-1– Axial Ambient Magnetic frequency distribution

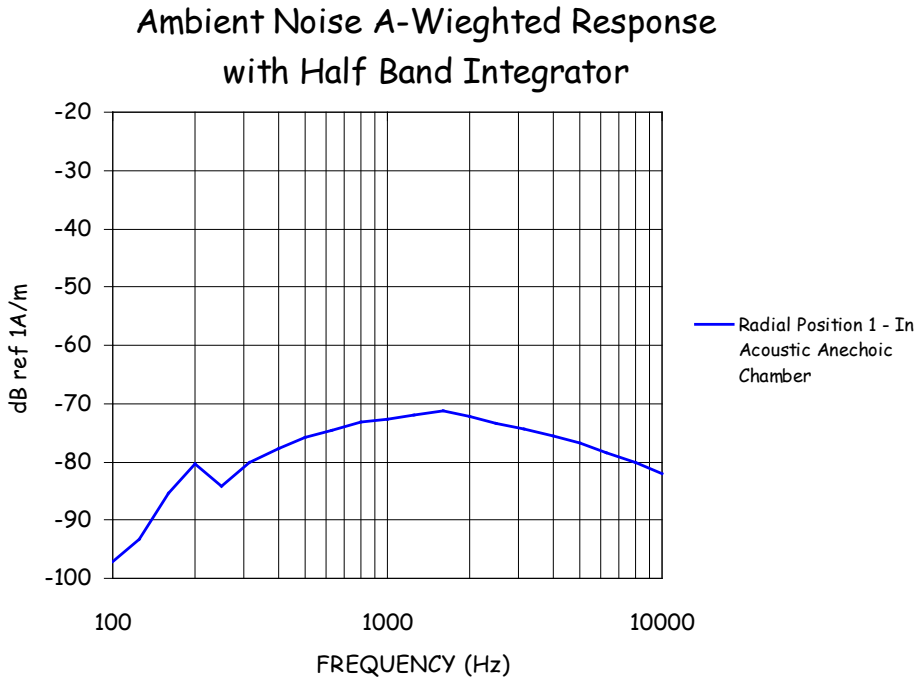


Figure 8-2 – Radial Position 1 Ambient Magnetic frequency distribution

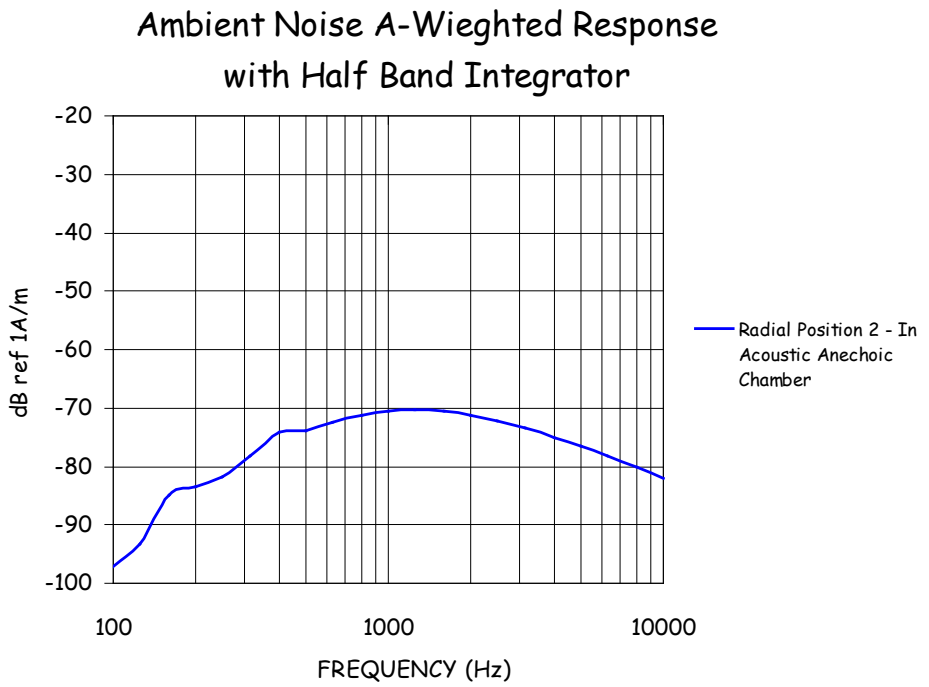


Figure 8-3 – Radial Position 2 Ambient Magnetic frequency distribution

9.0 Test Results Summary

The telecoil desired signal strength (ABM1) results per ANSI C63.19-2007, section 6.3.4.2 are shown in Section 9.2 for the 800 MHz band. The desired signal results are reported herein at the center of the 800 MHz bands only, as measured in a 1/3 octave bandwidth filter. The ABM1 frequency response plots for 800 MHz are shown in Section 9.1, and illustrate compliance with the ANSI C63.19-2007 limits given in Section 2. Signal quality results depend on the undesired signal strengths (ABM2) measured per ANSI C63.19-2007, Section 6.3.4.3 and are half band integrated with an A-weighted filter applied. The undesired signal results are plotted in Figures 9-2-1 and 9-2-2 for 800 MHz. The Desired-to-Undesired ABM signal strength ratio is taken to be the difference between the lowest signal strength measured and the greatest band-dependent interference level measured. This number is in bold and highlighted in **Blue**. Signal to Noise ratios are reported in Section 9.3 for the 800 MHz band. All measurements were made with backlighting off.

9.1 Axial frequency response plot data comparison:

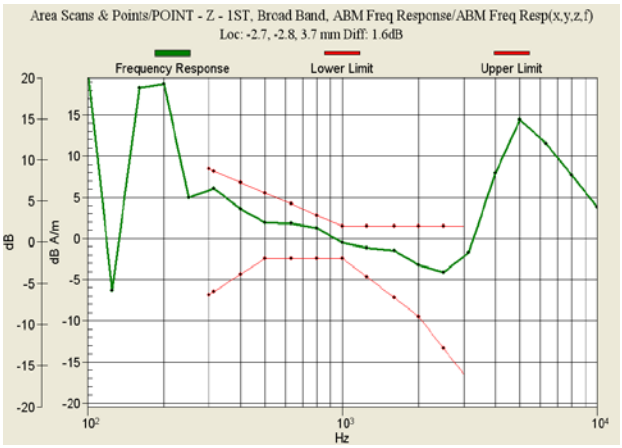


Figure 9-1-1: 800 MHz Measured Frequency Response (2:6).

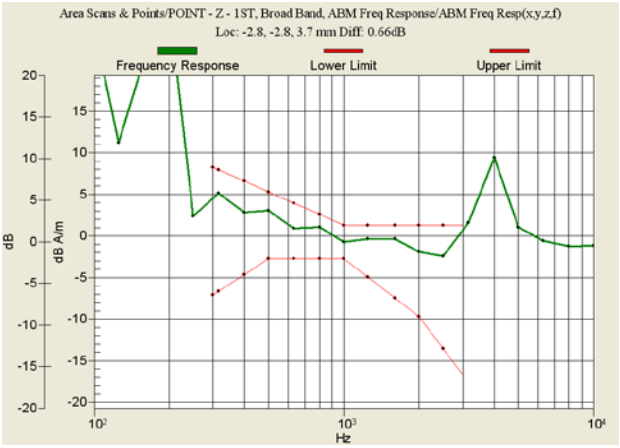


Figure 9-1-2: 800 MHz Measured Frequency Response (1:6).

The frequency responses above were measured with the DUT configured to optimize hearing aid inductive coupling frequency response, a setting selected by the user via the keypad.

These plots demonstrate that this model complies with the ANSI C63.19-2007 limits given in Section 7.3.2 and thus met the requirements of 47 CFR 20.19.

9.2 800 MHz Band Audio band magnetic (ABM) signal strength measured at 807.9125MHz

Measurement Orientation with 2:6 multiplexing	Desired signal ABM1 (dB A/m)	Undesired Signal ABM2 (dB A/m)
Axial	-0.463892	-36.1914
Radial 1	-9.45286	-44.934
Radial 2	-8.55789	-43.4103

Measurement Orientation with 1:6 multiplexing	Desired signal ABM1 (dB A/m)	Undesired Signal ABM2 (dB A/m)
Axial	**-0.685181**	-41.4913
Radial 1	**-9.69982**	-50.0569
Radial 2	-8.85639	-47.1823

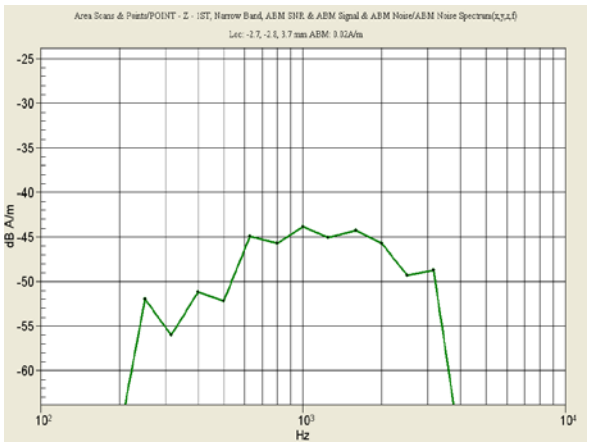


Figure 9-2-1: 800 MHz ABM2 Undesired Signal (2:6).

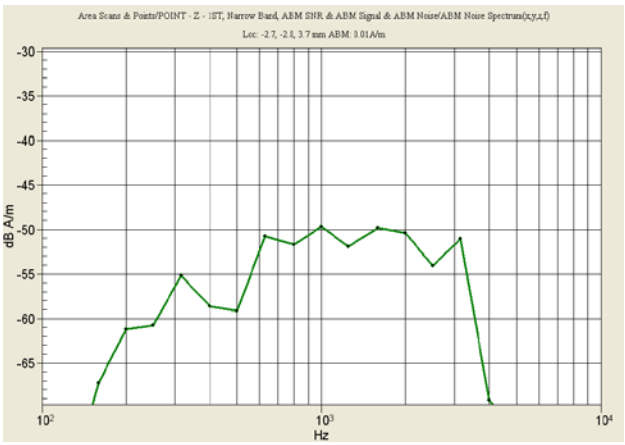


Figure 9-2-2: 800 MHz ABM2 Undesired Signal (1:6).

Considering that the user has no choice of multiplexing ratio the highlighted ABM1 axial and radial values are the minimum values that all users might experience. The ABM2 values reported are the greatest values measured for the battery type listed.

9.3 800 MHz Band Desired to Undesired ABM Signal Ratio

Measurement Orientation	ABM Ratio (dB) 2:6 Multiplexing	ABM Ratio (dB) 1:6 Multiplexing
Axial	35.73	40.81
Radial 1	35.48	40.36
Radial 2	34.85	**38.33**

9.4 Minimum ABM1 Signal Strength Summary

Given that users cannot select either the frequency band or the multiplexing ratio then the minimum signal strength all users will experience is evident by comparing the highlighted values in sections 9.2. Those values are:

Minimum axial: -0.685181 dB A/m
Minimum radial: -9.69982 dB A/m (at location radial 1)

Comparing the summaries in sections 9.3 and 9.4 with the ANSI C63.19-2007 limits in Section 2 then per the flow chart in Figure 2 it is evident that this model complies with the signal strength requirements mandated by FCC 47 CFR section 20.19.

9.5 Minimum Desired to Undesired Signal Ratio Summary

Given that users cannot select either the frequency band or the multiplexing ratio then the minimum signal strength all users will experience is evident by comparing the highlighted values in sections 9.3. The result is:

Minimum Desired to Undesired Signal: 38.33dB (in the 800 MHz band)

Comparing the measured desired to undesired signal ratio values listed in the tables of sections 9.3 with Table 1 in section 2 a rating of T4 may be justified based solely on audio band magnetic (ABM) measurements. Considering the RF interference potential this rating can be justified as long as the RF field strength warrants a rating of **T4** at the specific locations where the telecoil measurements were made.

10.0 Uncertainty budget

Table 7 - List of Uncertainties

Uncertainty of Audio Band Magnetic Measurements							
Error Description	Unc. Value	Prob. Dist.	Div.	(c_i) ABM1	(c_i) ABM2	Std. Unc. ABM1	Std. Unc. ABM2
Probe Sensitivity							
Reference Level	±3.0%	N	1	1	1	±3.0%	±3.0%
AMCC Geometry	±0.4%	R	$\sqrt{3}$	1	1	±0.2%	±0.2%
AMCC Current	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%
Probe Positioning during Calibr.	±0.1%	R	$\sqrt{3}$	1	1	±0.1,%	±0.1%
Noise Contribution	±0.7%	R	$\sqrt{3}$	0.0143	1	±0.0%	±0.4%
Frequency Slope	±5.9%	R	$\sqrt{3}$	0.1	1.0	±0.3%	±3.5%
Probe System							
Repeatability / Drift	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%
Linearity / Dynamic Range	±0.6%	R	$\sqrt{3}$	1	1	±0.4%	±0.4%
Acoustic Noise	±1.0%	R	$\sqrt{3}$	0.1	1	±0.1%	±0.6%
Probe Angle	±2.3%	R	$\sqrt{3}$	1	1	±1.4%	±1.4%
Spectral Processing	±0.9%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%
Integration Time	±0.6%	N	1	1	5	±0.6%	±3.0%
Field Disturbation	±0.2%	R	$\sqrt{3}$	1	1	±0.1%	±0.1%
Test Signal							
Ref. Signal Spectral Response	±0.6%	R	$\sqrt{3}$	0	1	±0.0%	±0.4%
Positioning							
Probe Positioning	±1.9%	R	$\sqrt{3}$	1	1	±1.1%	±1.1%
Phantom Thickness	±0.9%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%
DUT Positioning	±1.9%	R	$\sqrt{3}$	1	1	±1.1%	±1.1%
External Contributions							
RF Interference	±0.0%	R	$\sqrt{3}$	1	0.3	±0.0%	±0.0%
Test Signal Variation	±2.0%	R	$\sqrt{3}$	1	1	±1.2%	±1.2%
Combined Uncertainty							
Combined Std. Uncertainty (ABM Field)						±4.1%	±6.1%
Expanded Std. Uncertainty						**±8.1%**	**±12.3%**

11.0 Declaration of Conformity

Motorola, Inc. hereby declares that based on the data herein this model complies with the requirements of 47 CFR 20.19(b)(2) with a rating of T4 based on ANSI C63.19-2007.

ANNEX A (HAC Distribution Plots: E and H-Field RF Data)

Test Laboratory: Motorola - iDEN 800 E-Field 2:6

Serial: 364BNW1V6Z; FCC ID: IHDP56NB1
Procedure Notes: Battery Model #: BP6X SNN5874A; Vocoder Rate: 2:6; Device Position: Polystyrene Block
Communication System: iDEN 800, 1:3 or 2:6; Frequency: 824.98 MHz; Communication System Channel Nu
Duty Cycle: 1:3
Medium: Air; Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

DASY4 Configuration:

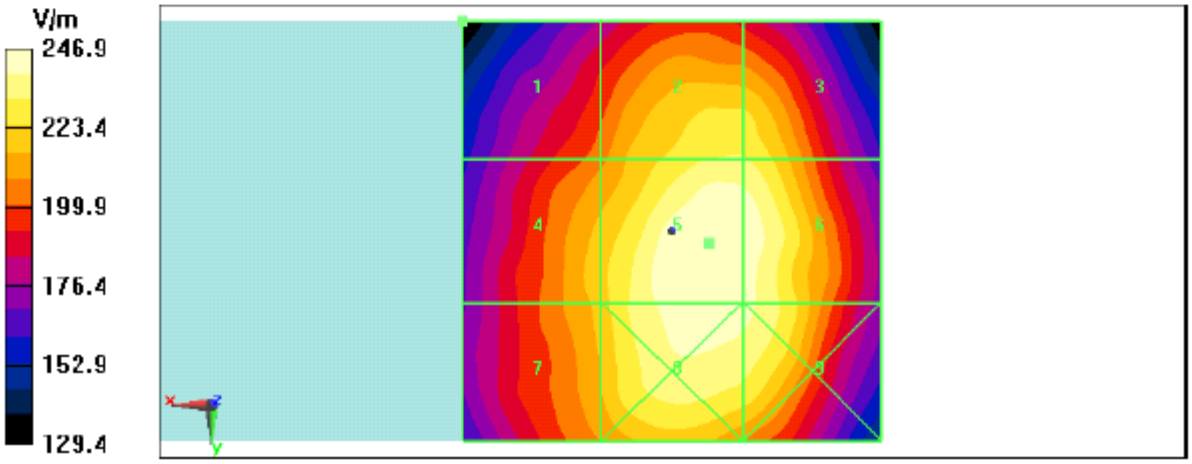
- Probe: ER3DV6 - SN2245; ConvF(1, 1, 1); Calibrated: 3/6/2012;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn699; Calibrated: 9/12/2012
- Phantom: R-6, HAC Test Arch (rev.2); Type: SD HAC P01 BA; Serial: 1071; Phantom section: RF Secti
- Measurement SW: DASY4, Version 4.7 (80);

E Scan - ER sensor center 15mm above WD Ref 3/HIGH CH, Hearing Compatibility Test (101x101x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm

Device Reference Point: 0, 0, -6.3 mm
Reference Value = 89.33 V/m; Power Drift = -0.00 dB
PMF = 3.480 Maximum value of peak Total field = 246.9 V/m
Near-field category: M3 (AWF 0 dB)

PMF scaled E-field

Grid 1 **M3** **205.9 V/m**	Grid 2 **M3** **232.8 V/m**	Grid 3 **M3** **232.3 V/m**
Grid 4 **M3** **221.6 V/m**	Grid 5 **M3** **246.9 V/m**	Grid 6 **M3** **245.0 V/m**
Grid 7 **M3** **219.8 V/m**	Grid 8 **M3** **243.6 V/m**	Grid 9 **M3** **241.4 V/m**



Test Laboratory: Motorola - iDEN 800 E-Field 1:6 Vocoder

Serial: 364BNW1V6Z; FCC ID: IHDP56NB1
Procedure Notes: Battery Model #: BP6X SNN5874A; Vocoder Rate: 1:6; Device Position: Polystyrene Block
Communication System: iDEN 800, 1:6; Frequency: 824.98 MHz; Communication System Channel Number:
Cycle: 1:6
Medium: Air; Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

DASY4 Configuration:

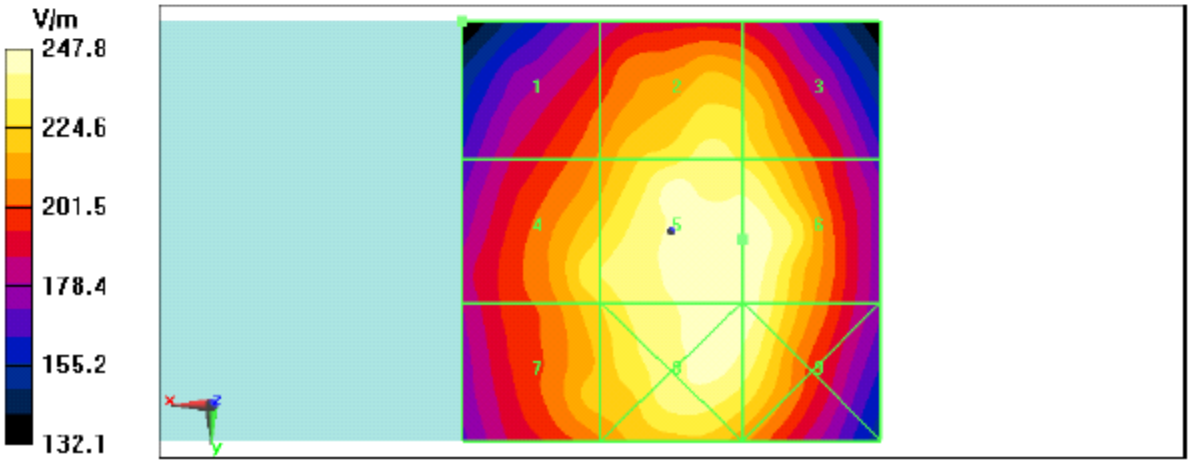
- Probe: ER3DV6 - SN2245; ConvF(1, 1, 1); Calibrated: 3/6/2012;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn699; Calibrated: 9/12/2012
- Phantom: R-6, HAC Test Arch (rev.2); Type: SD HAC P01 BA; Serial: 1071; Phantom section: RF Secti
- Measurement SW: DASY4, Version 4.7 (80);

E Scan - ER sensor center 15mm above WD Ref 3/HIGH CH, Hearing Compatibility Test (101x101x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm

Device Reference Point: 0, 0, -6.3 mm
Reference Value = 64.16 V/m; Power Drift = 0.048 dB
PMF = 4.900 Maximum value of peak Total field = 247.8 V/m
Near-field category: M3 (AWF 0 dB)

PMF scaled E-field

Grid 1 **M3** **211.3 V/m**	Grid 2 **M3** **236.2 V/m**	Grid 3 **M3** **231.2 V/m**
Grid 4 **M3** **232.5 V/m**	Grid 5 **M3** **247.8 V/m**	Grid 6 **M3** **247.8 V/m**
Grid 7 **M3** **225.7 V/m**	Grid 8 **M3** **246.3 V/m**	Grid 9 **M3** **245.2 V/m**



Test Laboratory: Motorola - iDEN 800 H-Field 2:6 Vocoder

Serial: 364BNW1V6Z; FCC ID: IHDP56NB1
Procedure Notes: Battery Model #: BP6X SNN5874A; Vocoder Rate: 2:6; Device Position: Polystyrene Block
Communication System: iDEN 800, 1:3 or 2:6; Frequency: 815.51 MHz; Communication System Channel Nu
Duty Cycle: 1:3
Medium: Air; Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

DASY4 Configuration:

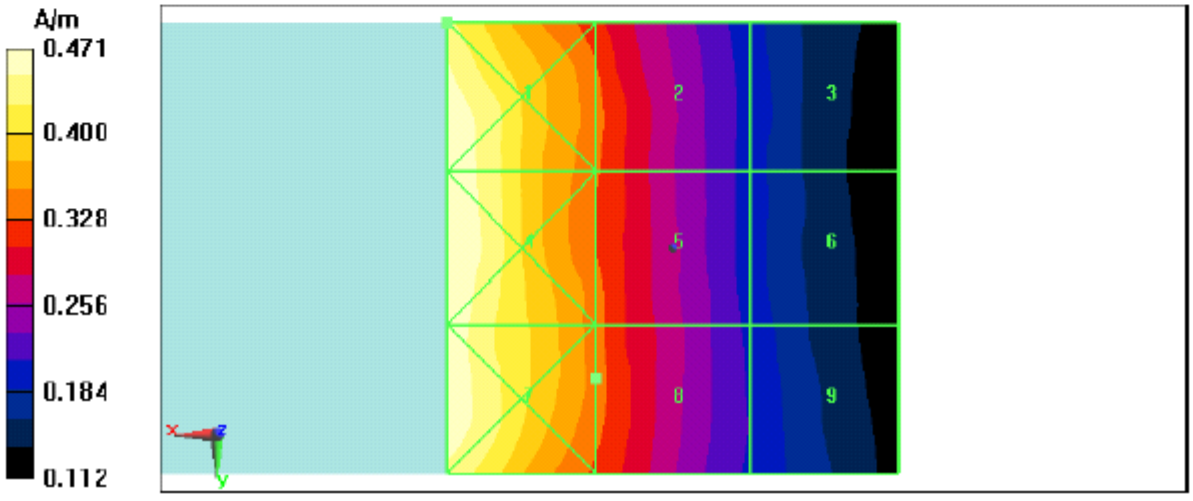
- Probe: H3DV6 - SN6075; ;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn661; Calibrated: 2/16/2012
- Phantom: R-6, HAC Test Arch (rev.2); Type: SD HAC P01 BA; Serial: 1071; Phantom section: RF Secti
- Measurement SW: DASY4, Version 4.7 (80);

H Scan - H3DV6 sensor center 15mm above WD Ref 2/MID CH, Hear Aid Compatibility Test (101x101x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm

Device Reference Point: 0, 0, -6.3 mm
Reference Value = 0.08900 A/m; Power Drift = 0.028 dB
PMF = 3.05 Maximum value of peak Total field= 0.341 A/m
Near-field category: M4 (AWF 0 dB)

PMF scaled H-field

Grid 1 **M4** **0.469 A/m**	Grid 2 **M4** **0.336 A/m**	Grid 3 **M4** **0.202 A/m**
Grid 4 **M4** **0.471 A/m**	Grid 5 **M4** **0.338 A/m**	Grid 6 **M4** **0.203 A/m**
Grid 7 **M4** **0.468 A/m**	Grid 8 **M4** **0.341 A/m**	Grid 9 **M4** **0.208 A/m**



Test Laboratory: Motorola - iDEN 800 H-Field 1:6 Vocoder

Serial: 364BNW1V6Z; FCC ID: IHDP56NB1
Procedure Notes: Battery Model #: BP6X SNN5874A; Vocoder Rate: 1:6; Device Position: Polystyrene Block
Communication System: iDEN 800, 1:6; Frequency: 815.51 MHz; Communication System Channel Number: 2
Cycle: 1:6
Medium: Air; Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

DASY4 Configuration:

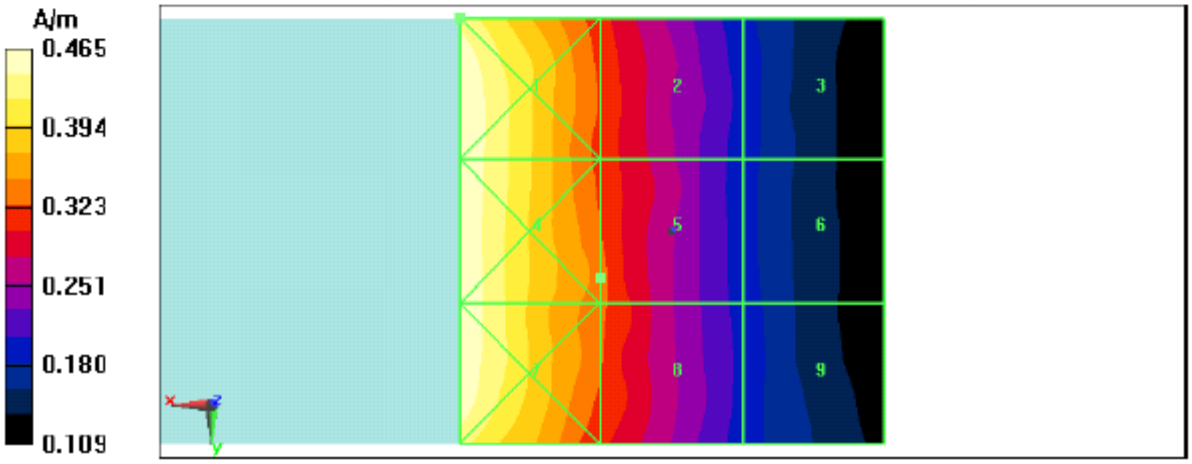
- Probe: H3DV6 - SN6075; ;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn661; Calibrated: 2/16/2012
- Phantom: R-6, HAC Test Arch (rev.2); Type: SD HAC P01 BA; Serial: 1071; Phantom section: RF Secti
- Measurement SW: DASY4, Version 4.7 (80);

H Scan - H3DV6 sensor center 15mm above WD Ref 2/MID CH, Hear Aid Compatibility Test (101x101x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm

Device Reference Point: 0, 0, -6.3 mm
Reference Value = 0.06100 A/m; Power Drift = 0.065 dB
PMF = 4.340 Maximum value of peak Total field = 0.334 A/m
Near-field category: M4 (AWF 0 dB)

PMF scaled H-field

Grid 1 **M4** **0.463 A/m**	Grid 2 **M4** **0.321 A/m**	Grid 3 **M4** **0.195 A/m**
Grid 4 **M4** **0.465 A/m**	Grid 5 **M4** **0.334 A/m**	Grid 6 **M4** **0.195 A/m**
Grid 7 **M4** **0.463 A/m**	Grid 8 **M4** **0.329 A/m**	Grid 9 **M4** **0.198 A/m**



ANNEX B (Manufacturer's Probe Calibration Certificates)

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
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 Hi-P

Certificate No: AM1D-1033_Oct12

CALIBRATION CERTIFICATE

Object	AM1DV2 - SN: 1033
Calibration procedure(s)	QA CAL-24.v3 Calibration procedure for AM1D magnetic field probes and TMFS in the audio range
Calibration date:	October 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	02-Oct-12 (No:12728)	Oct-13
Reference Probe AM1DV2	SN: 1008	12-Jan-12 (No. AM1D-1008_Jan12)	Jan-13
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
AMMI Audio Measuring Instrument	1062	26-Sep-12 (in house check Sep-12)	Sep-14

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	
Approved by:	Fin Bomholt	R&D Director	

Issued: October 19, 2012

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	**AM1DV2** Audio Magnetic 1D Field Probe
Type No	SP AM1 001 AF
Serial No	**1033**

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	July 25, 2006
Last calibration date	February 09, 2012

Calibration data

Connector rotation angle	(in DASY system)	**310.5 °**	+/- 3.3 ° (k=2)
Sensor angle	(in DASY system)	**3.95 °**	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	**0.0658 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%.

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

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 Hi-P

Certificate No: TMFS_1007_Oct12

CALIBRATION CERTIFICATE

Object / Identification	TMFS – SN: 1007
Calibration procedure(s)	QA CAL-24.v3 Calibration procedure for AM1D magnetic field probes and TMFS in the audio range
Calibration date	October 22, 2012

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The calibrations have been conducted in the R&D laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	02-Oct-12 (No:12728)	Oct-13
Secondary Standards	**ID #**	**Cal / Check Date**	**Scheduled Calibration Check**
AMCC	1050	12-Oct-11 (in house check Oct-11)	Oct-13
Reference Probe AM1DV2	SN: 1008	18-Jan-12 (No. AM1D-1008_Jan12)	Jan-13
AMMI Audio Measuring Instrument	1062	26-Sep-12 (in house check Sep-12)	Sep-14
Agilent WF Generator 33120A	MY40005266	12-Oct-11 (in house check Oct-11)	Oct-13
Keithley Multimeter Type 2001	SN: 0661047	22-Oct-12 (in house check Oct-12)	Oct-13

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	D. Iliev
Approved by:	Fin Bomholt	R&D Director	F. Bomholt

Issued: October 22, 2012

References

[1] ANSI-C63.19-2007
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.
[2] DASY manual, Chapter "Hearing Aid Compatibility (HAC) T-Coil Extension"

Methods Applied and Interpretation of Parameters

- *Coordinate System:* The TMFS is mounted underneath the HAC Test Arch touching equivalently to a wireless device according to [2] 29.2.2.: In "North" orientation, the TMFS signal connector is directed to the north, with x and y axes of TMFS and Test arch coinciding (see fig. 1). The rotational symmetry axis of the TMFS is aligned to the center of the HAC test Arch. For East, South and West configuration, the TMFS has been rotated clockwise in steps of 90°, so the connector looks into the specified direction. The evaluation of the radial direction is referenced to the device orientation (x equivalent to South direction).

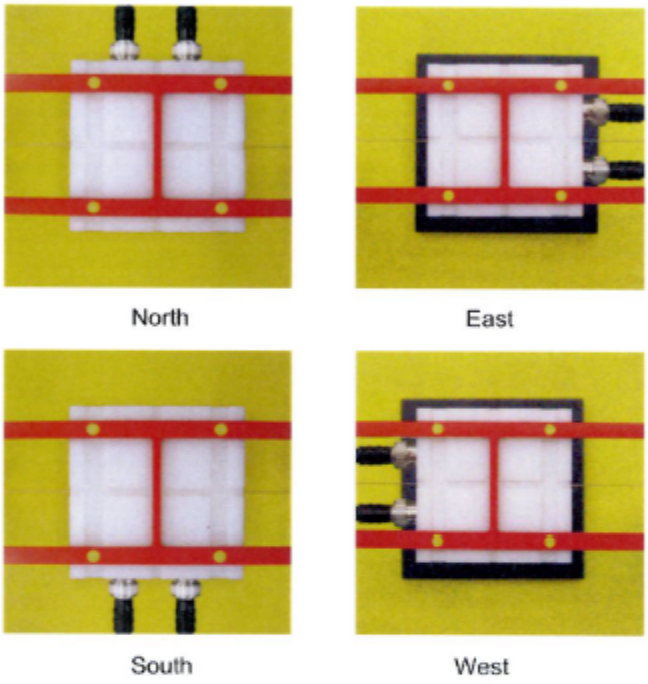


Fig. 1 TMFS scanning measurement configurations

- *Measurement Plane:* In coincidence with standard [1], the measurement plane (probe sensor center) is selected to be at a distance of 10 mm above the the surface of the TMFS touching the frame. The 50 x 50 mm scan area is aligned to the center of the unit. The scanning plane is verified to be parallel to the phantom frame before the measurements using the predefined "Geometry and signal check" procedure according to the predefined procedures described in [2].

- *Measurement Conditions:* Calibration of AM1D probe and AMMI are according to [2]. The 1 kHz sine signal for the level measurement is supplied from an external, independent generator via a BNC cable to TMFS IN and monitored at TMFS OUT with an independent RMS voltmeter or Audio Analyzer. The level is set to 0.5 Vrms and monitored during the scans.

- For the *frequency response*, a higher suppression of the background ambient magnetic field over the full frequency range was achieved by placing the TMFS in a magnetically shielded box. The AM1D probe was fixed without robot positioner near the axial maximum for this measurement. The background noise suppression was typ. 30 dB at 100 Hz (minimum) and 42 dB at 1 kHz. The predefined multisine signal (48k_multisine_50-10000_10s.wav) was used and evaluated in the third-octave bands from 100 Hz to 10000 Hz.

1 Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.8.3 (988)
DASY PP Version	SEMCAD	V14.6.7 (6848)
Phantom	HAC Test Arch	SD HAC P01 BA, #1002
Distance TMFS Top - Probe Centre	10 mm	
Scan resolution	dx, dy = 5 mm	area = 50 x 50 mm
Frequency	for field scans	1 kHz
Signal level to TMFS	for field scans	500 mV RMS
Signal	for frequency response	multisine signal 50-10000 Hz, each third-octave band

Table 1: System configuration

2 Axial Maximum Field

Configuration	East	South	West	North	Subset Average	Average
Axial Max	-20.34	-20.36	-20.36	-20.35		**-20.35**
TMFS Y Axis 1st Max	-26.09	-26.13	-26.14	-26.09		
TMFS Y Axis 2nd Max	-25.78	-25.80	-25.78	-25.79		
Longitudinal Max Avg	-25.94	-25.97	-25.96	-25.94	**-25.95**	
TMFS X Axis 1st Max	-25.84	-26.01	-25.96	-25.86		
TMFS X Axis 2nd Max	-26.10	-26.23	-26.22	-26.18		
Transversal Max Avg	-25.97	-26.12	-26.09	-26.02	**-26.05**	
Radial Max						**-26.00**

Table 2: Axial and radial field maxima measured with probe center at 10mm distance in dB A/m

The maximum was calculated as the average from the values measured in the 4 orientations listed in table 2.

Axial Maximum **-20.35 dB A/m** (+/- 0.33dB, k=2)

3 Radial Maximum Field

In addition, the average from the 16 maxima of the radial field listed in table 2 (measured at 10mm) was calculated:

Radial Maximum **-26.0 dB A/m**

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%.

4 Appendix

4.1 Frequency response

Max. deviation measured, relative to 1 kHz: **min. -0.03, max. 0.00 dB**

Frequency [Hz]	Response [dB]
100	-0.02
125	-0.01
160	-0.01
200	-0.01
250	-0.01
315	-0.01
400	0.00
500	0.00
630	-0.01
800	0.00
1000	**0.00**
1250	-0.01
1600	-0.01
2000	-0.01
2500	-0.01
3150	-0.01
4000	-0.02
5000	-0.02
6300	-0.03
8000	-0.03
10000	-0.03

Table 3: Frequency response

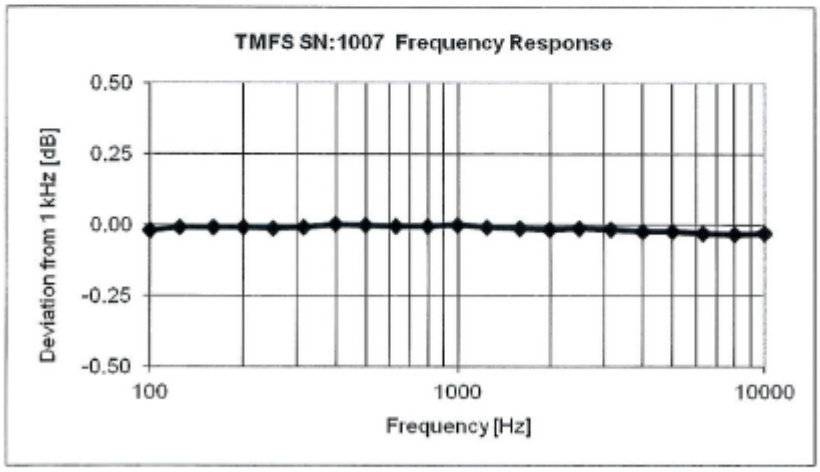


Fig. 2 Frequency response 100 to 10'000 Hz

4.2 Field plots

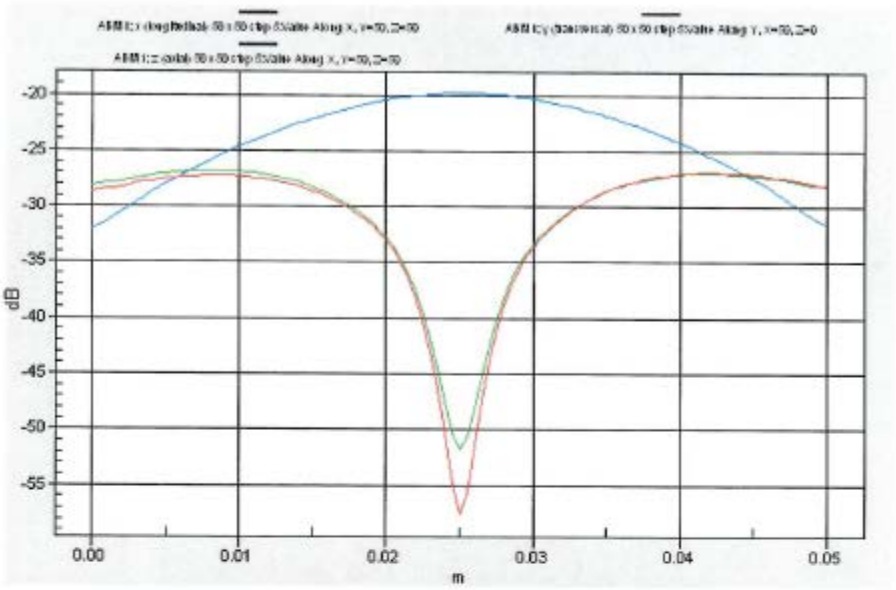


Fig. 3: Typical 2D field plots for x (red), y (green) and z (blue) components

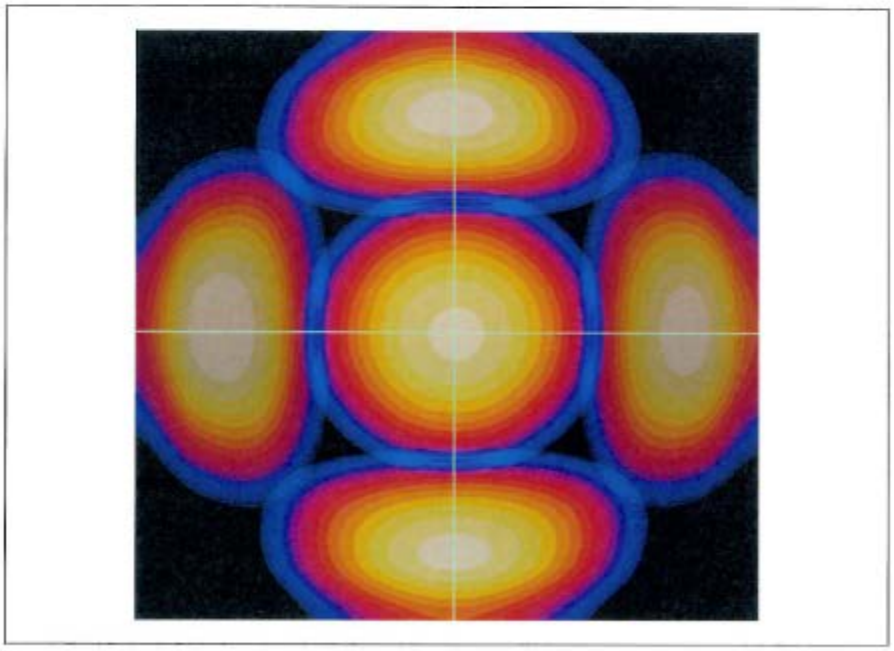


Fig. 4: Superponed field plots of z (axial), x and y radial magnetic field, 50 x 50 mm, individual scaling: white = max. field level, black = -4dB below max. The lines show the position of the 2D field plot of figure 3.