MOTOROLA

FCC ID: AZ489FT5844
DECLARATION OF COMPLIANCE HAC ASSESSMENT - TELECOIL

iDEN Mobile Devices
Audio Test Laboratory
8000 West Sunrise Blvd
Fort Lauderdale, FL. 33322

Date of Report: May 12, 2006
Report Revision: Rev. O
Report ID: FCC_HAC_Telecoil_Rpt_i670_Rev O

Responsible Engineer:	Joe Friedman
Date/s Tested:	4/6/2006
Manufacturer/Location:	Motorola – Plantation, Florida
Sector/Group/Div.:	iDEN Mobile Devices
Date submitted for test:	22 Mar. 2006
DUT Description:	Clamshell style with extendable antenna
Signaling type:	TDMA: iDEN
Test TX mode(s):	2:6 (a.k.a. 1:3), 1:6
Max. Power output:	0.640W; Pulse Average; Factory tuning
Nominal Power:	0.600W; Pulse Average; Factory tuning
TX Frequency Bands:	iDEN - 806-825 MHz, 896-902 MHz
Model(s) Tested:	i670 (H91XAH6RR4AN)
Model(s) Certified:	i670 (H91XAH6RR4AN)
Serial Number(s):	364KGE1BP5
Rule Part(s):	20.19(b)(2)

Approved Applicable Accessories:

Antenna(s):

8585744F04 - 806-928 MHz extendable ¼ wave antenna
Gain - 806-825MHz: -2.4 dBd; 896-902MHz: -1.1 dBd;

Battery(ies):

SNN5705C High Performance Li Ion, Battery Cover NNTN2349NA

Min. Axial field strength:	**-6.58 dB A/m**
Min. Radial field strength:	**-13.53 dB A/m**
Min. ABM Desired-to-Undesired signal ratio:	**25.18 dB**
HAC Category rating:	**M3 T3**

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Motorola iDEN Mobile Devices Business

/s/ Alfred Wieczorek **Approval Date:** 12 May 2006

Certification Date: 12 May 2006

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REVISION HISTORY

Date	Revision	Comments
4/6/06	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 PC63.19-2001 rd 3.6 standard. The data in this report is for assessing T-coil compliance only, as a separate report was previously filed with near-field performance data for assessing RF Interference potential. Some relevant data extracted from that report are included in Appendix A.

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 C63.19-2001 rd 3.6 section 7.3)

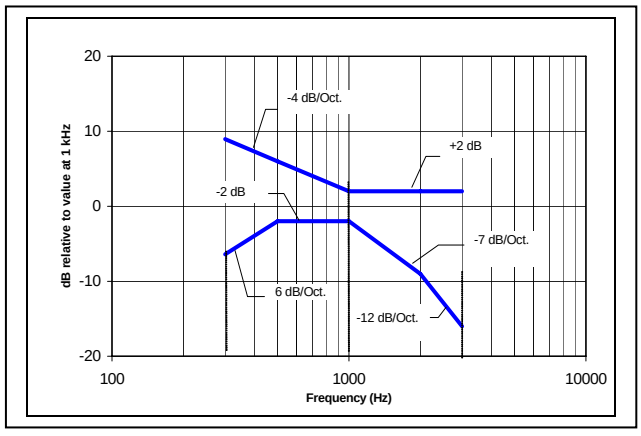
The signal quality rating shall be T3 or better per 47 CFR 20.19. Per C63.19 this rating is dependent upon the articulation weighting factor (AWF) for specific air interface protocols as listed in the following table:

Table 1 – Signal Quality rating limits

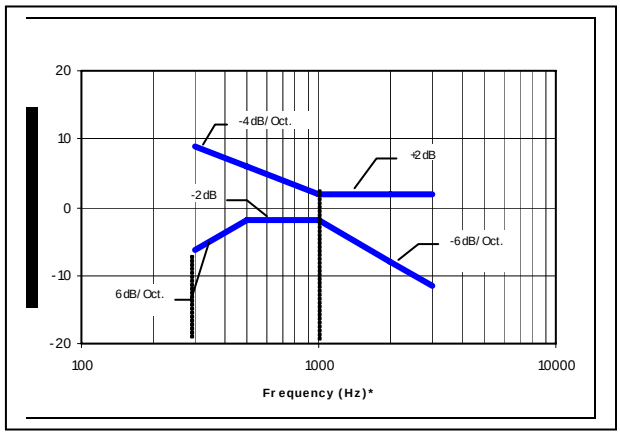
Rating	AWF = 0	AWF = 5
T4	> 30 dB	> 35 dB
T3	20 to 30 dB	25 to 35 dB

To merit this rating the axial component of the audio band magnetic (ABM) field shall be ≥ -13 dB A/m at 1 kHz, and the radial components of the audio band magnetic 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 graph:



A – Mask for WDs with a field that exceeds -10 dB(A/m) at 1 kHz



B - Mask for WDs with a field t between -10 to -13 dB at 1kHz

Figure 1 –Frequency Response (Axial only)

The current C63.19 methodology used to determine a wireless device (WD) T-category rating is illustrated in the attached flow chart in Figure 1. 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.

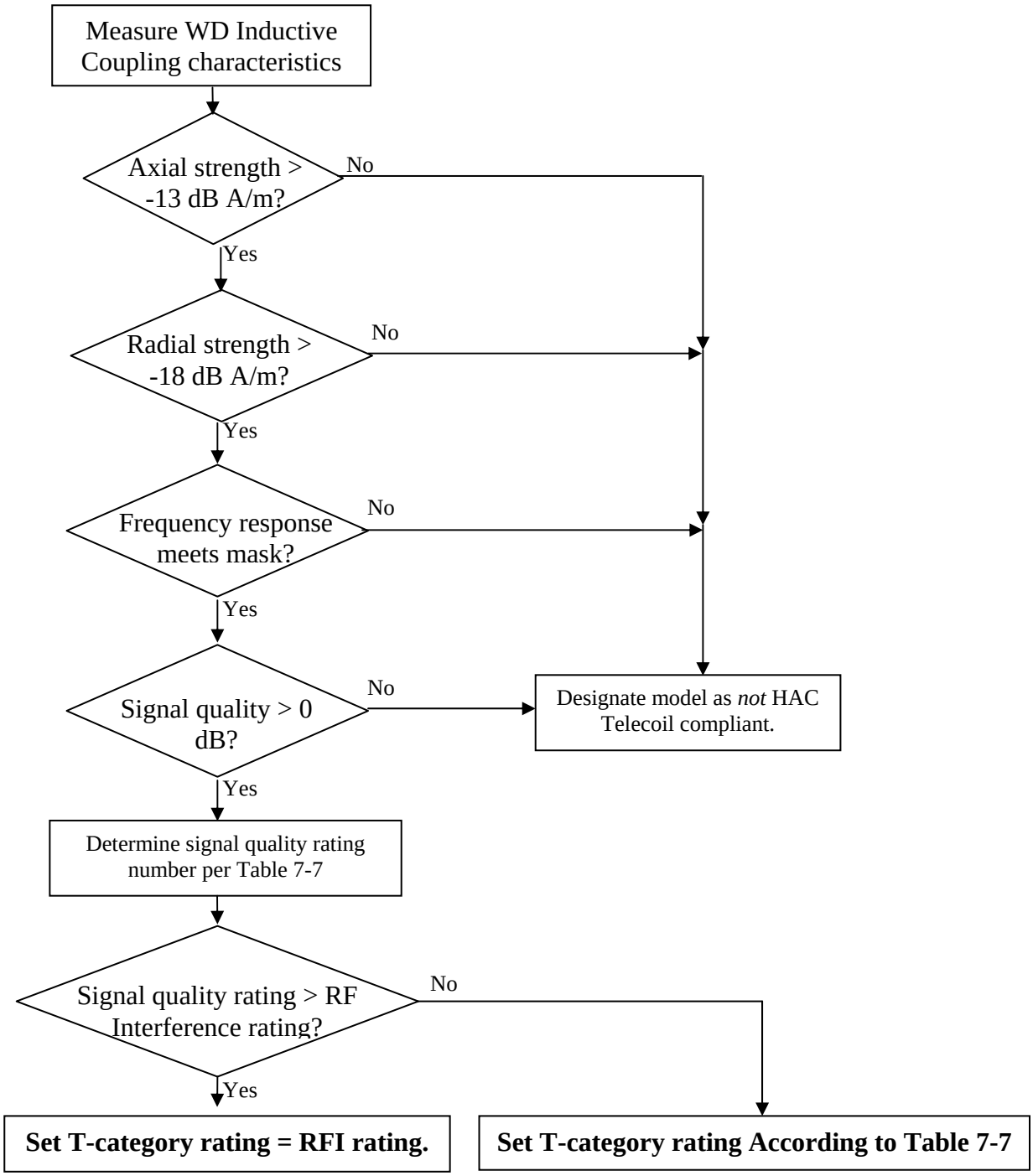


Figure 2 - WD Telecoil Category Rating Process
(Note: RFI rating assumed to be M3 or M4)

3.0 Description of Device Under Test (DUT)

FCC ID: AZ489FT5844 is used for telephone service subject to 47 CFR 20.19 for hearing aid compatibility. The model tested here, known as the i670, is a variant of the i560 handset, which obtained its M3 rating on a grant issued 8 August 2005. The i670 was likewise evaluated for HAC (RF Interference) performance, and it was deemed comparable, and so shares the M3 rating via a Class I Permissive Change (in accordance with 47 CFR 2.1043).

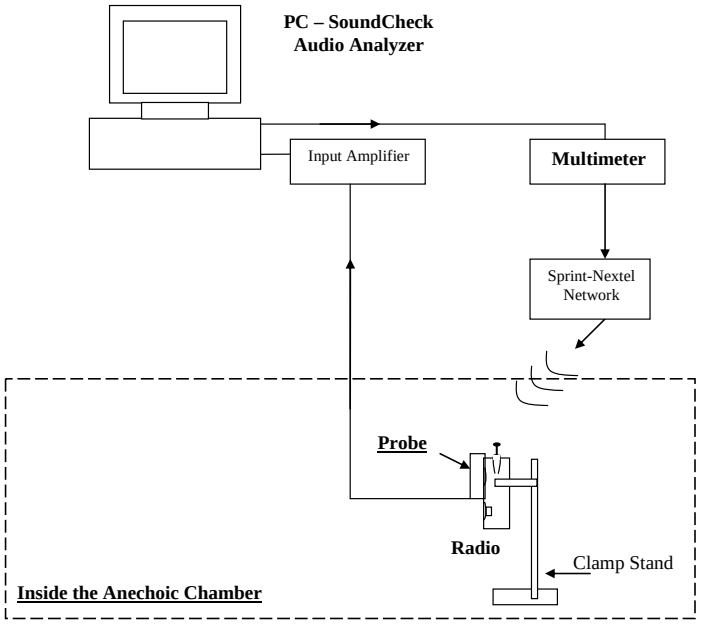
The maximum output power is 0.640 watts pulse average as determined by the upper limit of the production line final test station. The DUT was tuned to be within 5% of the maximum rated power. It is capable of transmitting on any network commanded frequency in the bands of 806 to 821 MHz (within the United States) and 896 to 901 MHz. 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. A different Vocoder is used for each multiplexing factor as commanded by the cellular network. User controls include selecting the duration of the backlight duration and the audio frequency response characteristic.

4.0 Test Equipment List

Table 2 – List of test equipment used

Equipment Type	Model Number	Serial Number	Calibration Due
Axial Probe	HAC – A100	0484	1 Jun 06
Radial Probe	HAC – R100	0484	1 Jun 06
Audio Analyzer software	SoundCheck 6.1	SC-421	1 Jun 06
Sound card – 24 bit/96k Hz	Card Deluxe	06416	1 Jun 06
Input amplifier	SoundConnect	PS-418	1 Jun 06
Telephone Magnetic Field Simulator APREL TMFS v.1.6, Release 23 March 2005	TMFS-1	300-01151	12 Apr 06

5.0 Descriptions of Measurement System (a variation of PC63.19-2001 rd 3.5 Figure 6-1)



6-1)

Figure 3 – Test setup

The laboratory utilizes the Listen SoundCheck system, which is a software package that both generates and measures audio signals via a D/A card installed in a personal computer. This software provides the filtering and integration functions necessary to complete the measurements in C63.19, section 6.3.4.2 and 6.3.4.3. The P50 male audio signal so generated is applied to the DUT which is engaged in an on-network telephone call as the antenna is not removable and the antenna port connector lies between the battery and the housing. Transmission power was monitored via embedded diagnostic software that displays output power to ensure no power cutback occurred. The measurement system consists of a CCL A-100 Axial telecoil probe and an R-100 Radial telecoil probe. Section 4.0 presents relevant test equipment information. All measurement equipment used to assess Telecoil HAC compliance was calibrated.

6.0 Measurement System Verification

The HAC measurements were conducted with Axial and Radial telecoil probes model/serial numbers A-100/0484 and R-100/0484. 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 3. The photos below depict the validation setup using the TMFS.

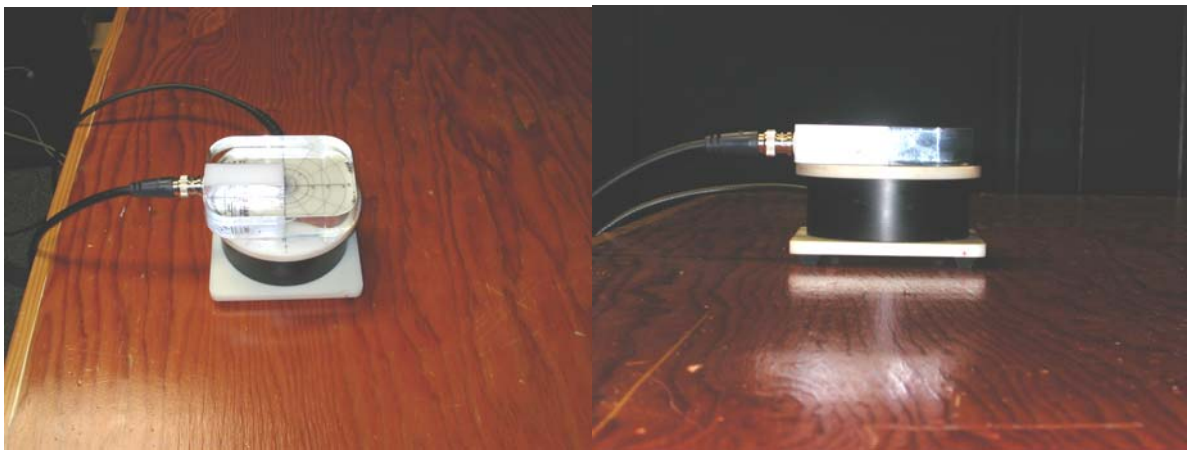


Figure 4 – Probe coil being calibrated with TMFS

6.1 System Verification Test Results

In accordance with C63.19-2005 clause 6.2.4 the probes were calibrated and sensitivity levels at 1 kHz verified and listed below on 10 February 2006. System verification measurement results for Axial and Radial probes are listed and compared with expected values from the TMFS in Table 3. The amplitude linearity data shown below meets the ± 0.5 dB tolerance, with the output varying in corresponding 10 dB steps.

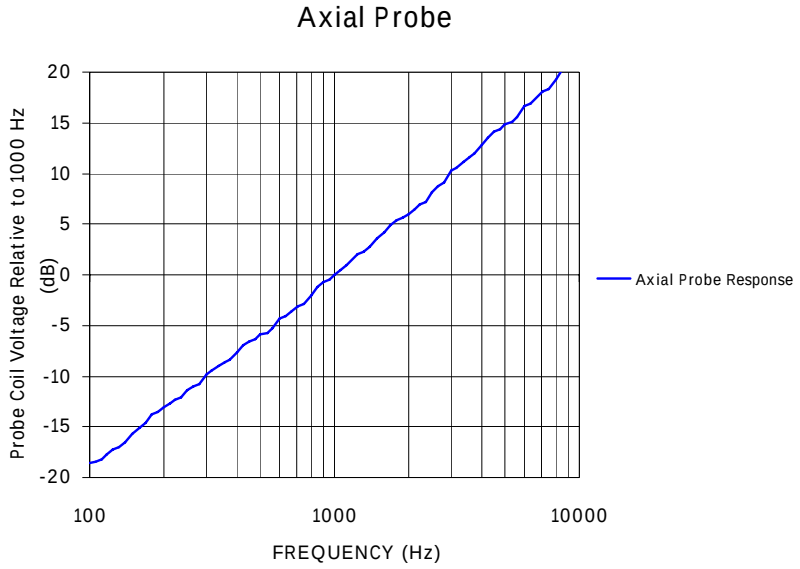


Figure 5 - Axial Probe sensitivity at 1000 Hz: -58.5 dB V/(A/m)

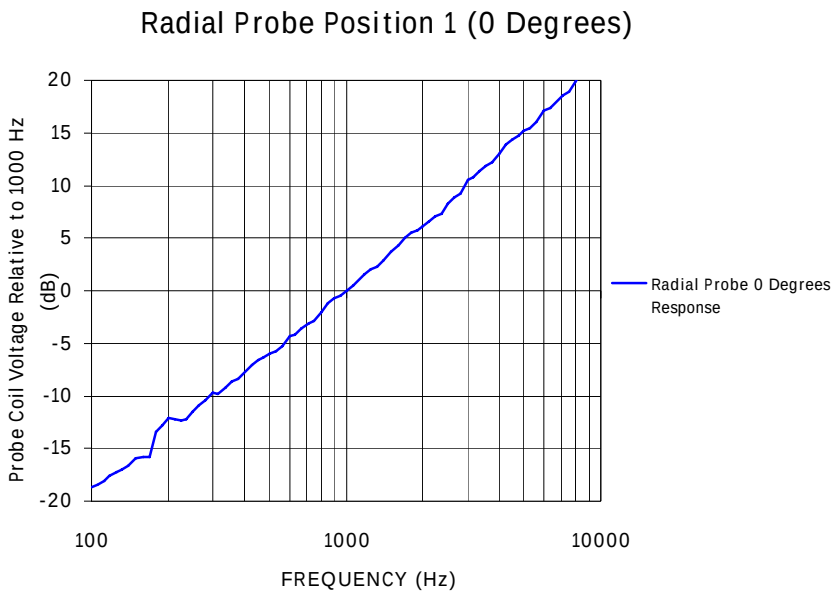


Figure 6 - Radial Probe sensitivity at 1000 Hz: -59.9 dB V/(A/m)

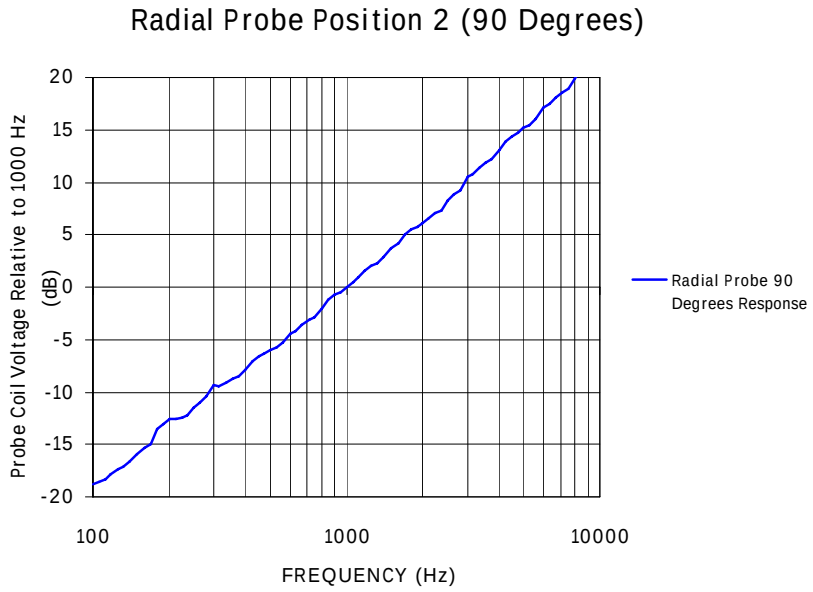


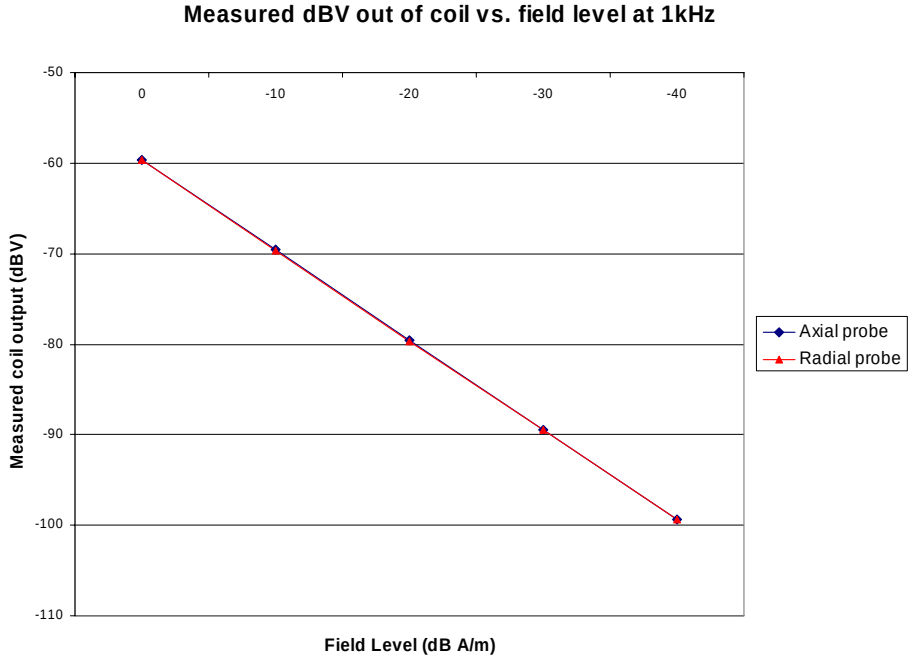
Figure 7 - Radial Probe sensitivity at 1000 Hz: -59.9 dB V/(A/m)

Table 3 - Probe Sensitivity

Orientation	Input Signal	Target Magnetic Field	Measured Magnetic field	Deviation
Axial	1kHz, 0.5V	-20.0 dB A/m	-20.66 dB A/m	0.66 dB
Radial 1	1kHz, 0.5V	-27.5 dB A/m	-28.08 dB A/m	0.58 dB
Radial 2	1kHz, 0.5V	-27.5 dB A/m	-27.90 dB A/m	0.40 dB

Table 4 - Probe Linearity

Level	Delta of Axial Probe @ 1kHz	Delta of Radial Probe @ 1kHz	Within +/-.5 dB
0-10	10.00	10.00	Pass
10-20	10.00	10.00	Pass
20-30	9.80	9.80	Pass
30-40	9.90	9.80	Pass



7.0 DUT Setup and Test Procedure

The test setup was done as specified in C63.19-2005 section 6.3.2 and Figure 6-1. Axial and radial measurements were performed at locations in accordance with C63.19 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 2. The test flow and procedure was per C63.19 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 a P50 male signal was sent to the DUT. The signal was then measured with the telecoils and analyzed for frequency response and level. The test results were obtained with:

- The antenna extended,
- 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 2):
    - 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 8 – Test holder

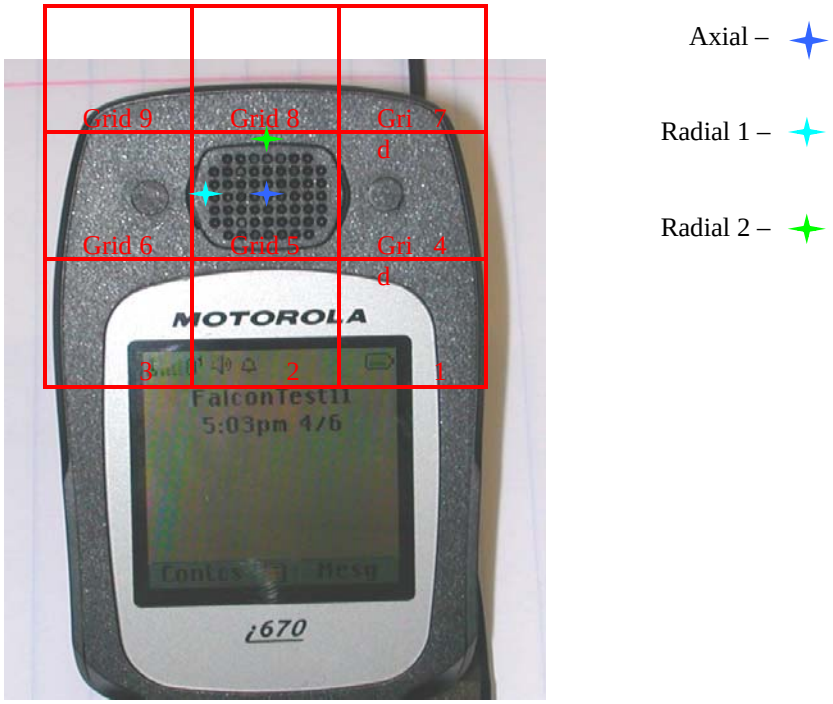


Figure 9 – Measurement location coordinates

Table 5 – Measurement location coordinates

Location	X coordinate (mm)	Y coordinate (mm)	Subgrid Number (See Appendix A)
Axial -	0	0	5
Radial 1 -	-7.8	0	5
Radial 2 -	0	-6.5	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 C63.19-2001 rd 3,6).

8.0 Environmental Test Conditions

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

Table 6 – 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 PC63.19-2001-rd3.6 section 6.2.1. The following graph shows the results obtained using a 1/3rd octave resolution bandwidth filter.

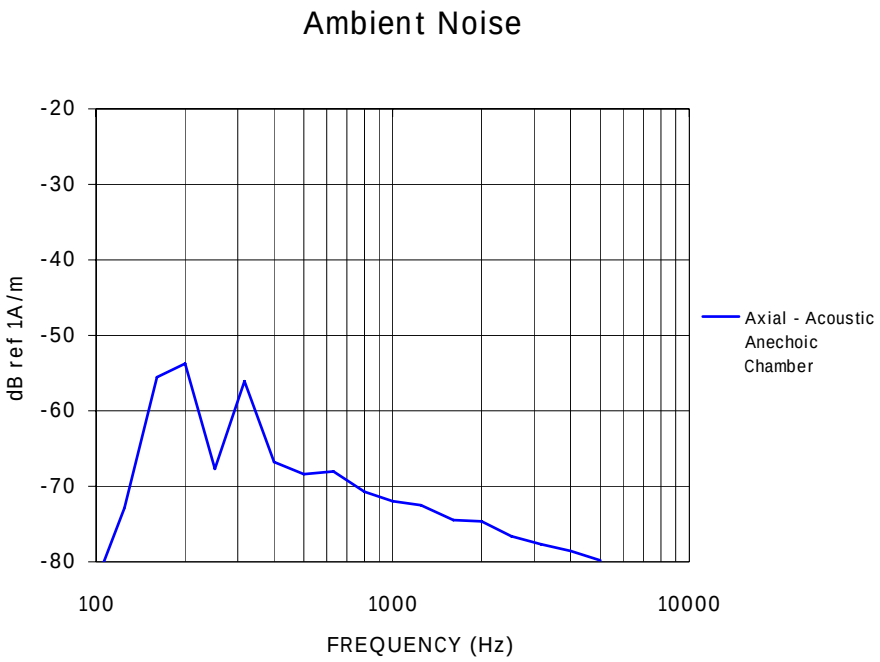


Figure 9A– Axial Ambient Magnetic frequency distribution

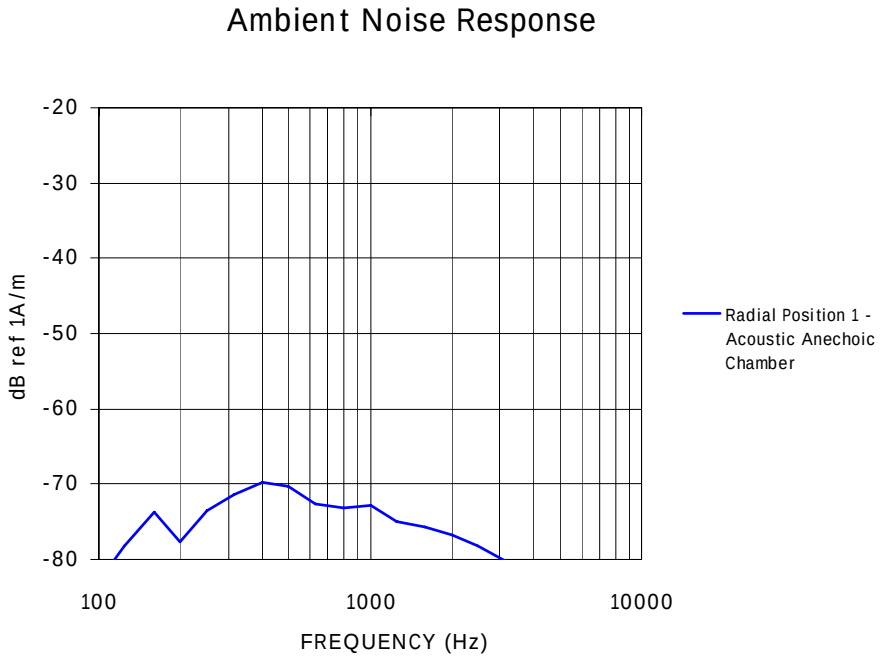


Figure 9B – Radial Position 1 Ambient Magnetic frequency distribution

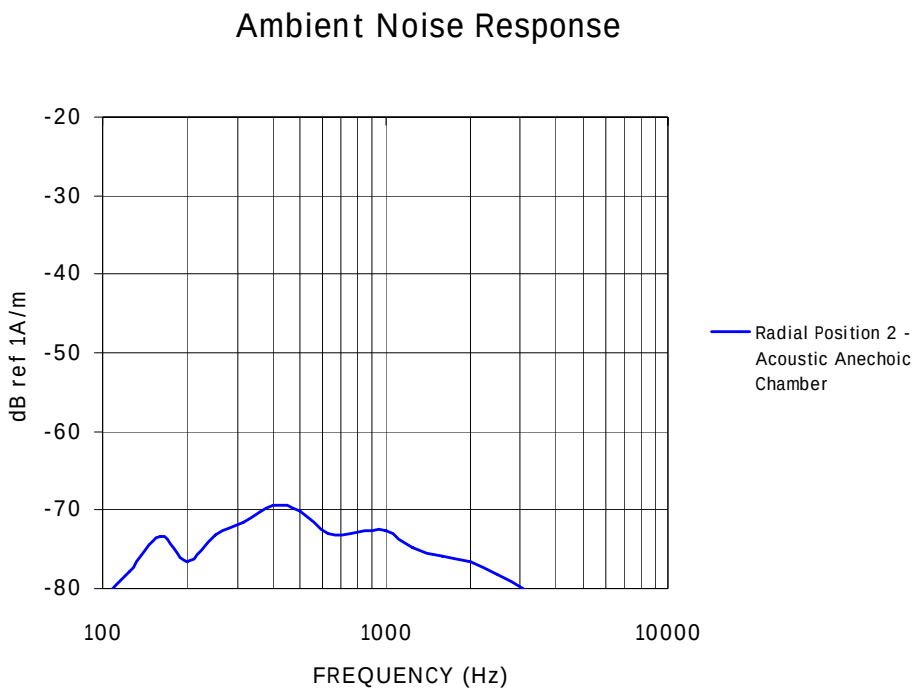


Figure 9C – Radial Position 2 Ambient Magnetic frequency distribution

9.0 Test Results Summary

The telecoil desired signal strength (ABM1) results per C63.19-2001 rd 3.6 section 6.3.4.2 are independent of the frequency used for transmission. However, the power amplifier current and consequent induced interference noise signals are expected to vary between the frequency bands due to antenna matching and amplifier efficiency variations affecting battery currents. As a result the desired signal results are reported herein at the center of the 800 MHz band only, as measured in a 1/3 octave bandwidth filter. However, signal quality results depend on the undesired signal strengths (ABM2) measured per C63.19-2001 rd 3.6 Section 6.3.4.3 (in an A-weighted filter), so undesired signal results follow for both bands. 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. All measurements were made with backlighting off.

9.1 Axial frequency response plot data comparison:

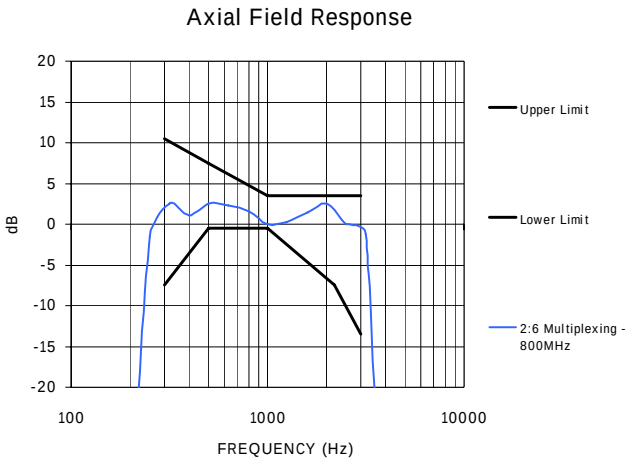


Figure 10A – 800MHz Measured Frequency response

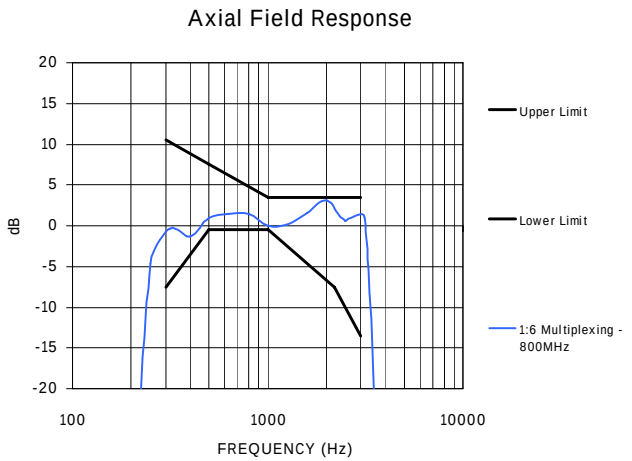


Figure 10B – 800MHz Measured Frequency response

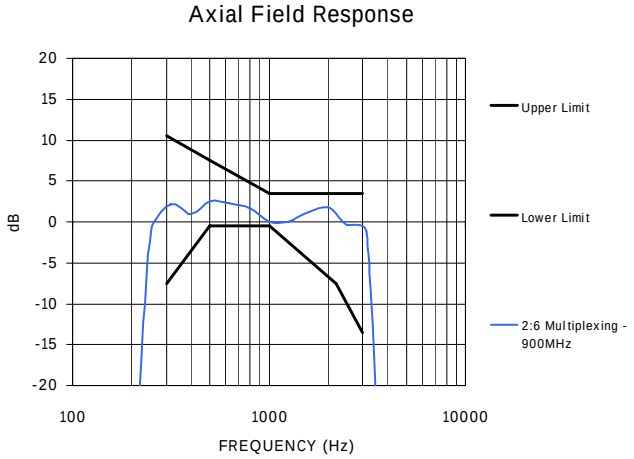


Figure 10C – 900MHz Measured Frequency response

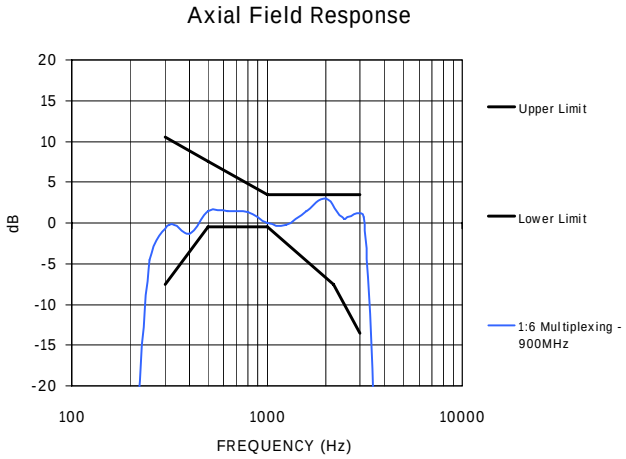


Figure 10D – 900MHz Measured Frequency response

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 C63.19 limits given in Section 2 and thus met the requirements of 47 CFR 20.19.

9.2 800 MHz Band Audio band magnetic (ABM) signal strength measured at 809.8625 MHz

Measurement Orientation with 2:6 multiplexing	Desired signal ABM1 (dB A/m)	Undesired Signal ABM2 (dB A/m)
Axial	**-6.58**	**-41.87**
Radial 1	**-13.42**	**-63.52**
Radial 2	**-13.44**	**-69.83**

Measurement Orientation with 1:6 multiplexing	Desired signal ABM1 (dB A/m)	Undesired Signal ABM2 (dB A/m)
Axial	**-5.31**	**-59.41**
Radial 1	**-12.56**	**-70.12**
Radial 2	**-12.04**	**-61.86**

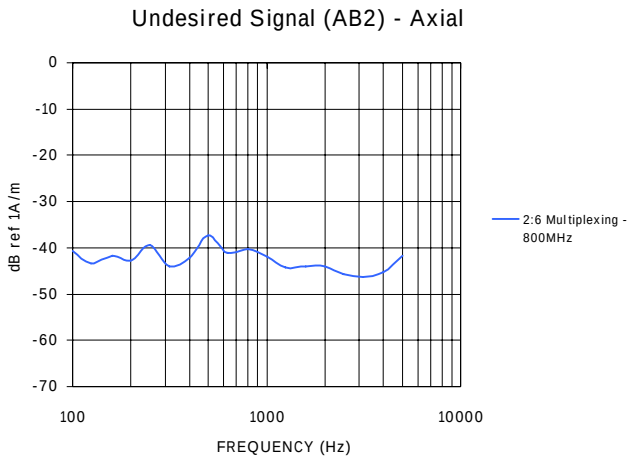


Figure 12A – 800MHz Undesired Signal (2:6)

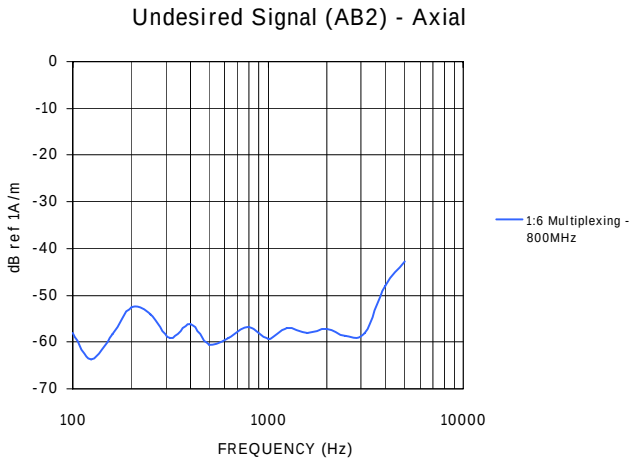


Figure 12B – 800MHz Undesired Signal (1:6)

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 2 battery types 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	35.29	54.10
Radial 1	50.10	57.56
Radial 2	56.39	58.14

9.4 900 MHz Band Audio band magnetic (ABM) signal strength measured at 900.0687 MHz

Measurement Orientation with 2:6 multiplexing	Desired signal ABM1 (dB A/m)	Undesired Signal ABM2 (dB A/m)
Axial	-6.51	-31.69
Radial 1	-13.53	-41.29
Radial 2	-13.53	-60.79

Measurement Orientation with 1:6 multiplexing	Desired signal ABM1 (dB A/m)	Undesired Signal ABM2 (dB A/m)
Axial	-5.16	-41.05
Radial 1	-12.75	-42.81
Radial 2	-12.38	-61.86

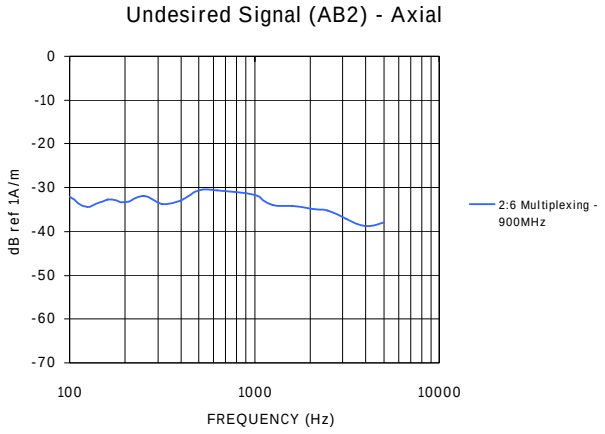


Figure 12A – 900MHz Undesired Signal (2:6)

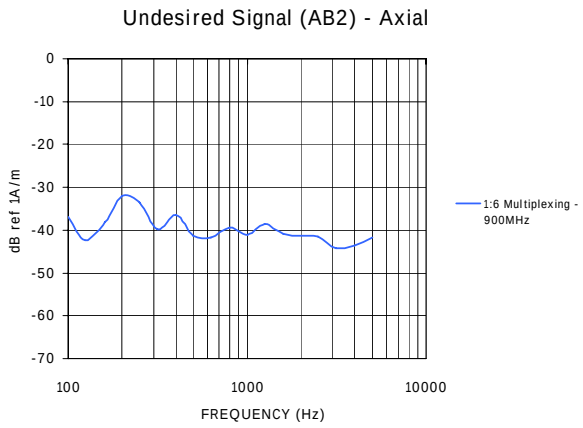


Figure 12B – 900MHz Undesired Signal (1:6)

The ABM2 value reported was the highest value measured for the 2 battery types listed.

9.5 900 MHz Band Desired to Undesired ABM Signal Ratio

Measurement Orientation	ABM Ratio (dB) 2:6 Multiplexing	ABM Ratio (dB) 1:6 Multiplexing
Axial	**25.18**	**35.89**
Radial 1	**27.76**	**30.06**
Radial 2	**47.26**	**49.48**

9.6 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 and 9.4. Those values are:

Minimum axial: -3.91 dB A/m
Minimum radial: -11.39 dB A/m (at location radial 1)

Comparing the summaries in sections 9.6 and 9.7 with the C63.19 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.

9.7 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 and 9.5. The result is:

Minimum Desired to Undesired Signal: -28.76 dB (in the 800 MHz band)

Comparing the measured desired to undesired signal ratio values listed in the tables of sections 9.3 and 9.5 with Table 1 in section 2 a rating of M3 T3 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 M3 at the specific locations where the telecoil measurements were made.

10.0 Category Rating Determination

Table 4 in section 7 lists the coordinates of the telecoil measurement locations and the RF interference measurement subgrids where the telecoil measurements were made. For both the axial and the radial desired to undesired signal ratios these lie in sub-grid 5 of the 50-mm grids shown in Annex A which are shown in Section 7, Figure 9 of this report. In each of these 16.67-mm square sub-grids a numerical value is listed respectively corresponding to the maximum 800 MHz band RF E-field and H-field strength values measured in those subgrids, not all of which were included in determining the M-category rating. The RF signal strength measurements were taken for this model (*FCC HAC rpt_i560_Rev B_050913*, dated 9/13/2005) and previously filed with the FCC, establishing HAC compliance with an M3 rating.

The maximum values from the six included subgrids were then listed in Table 3, which was extracted from that report, and placed into Annex A.1 of this report. Specifically the values listed in that table were those associated with subgrids 5. These were then compared with the criteria in section 2 therein to determine the M3 rating for this wireless device when measured with the grid centered at the center of the acoustic output (which is coincident with the axial location). The RF signal strengths at the telecoil measurement locations did not exceed those in the grids used to determine the M-category rating.

Since per Figure 2 the numerical value of the M rating is equal to the numerical value of the T rating (T3), as determined in this report, M3 T3 becomes the correct HAC rating for this model.

11.0 Uncertainty budget

Table 7 - List of Uncertainties

Contributor	Data (dB)	Data type	Probability distribution	Divisor	Std. uncertainty (dB)
RF reflections	+/- 0.8	Specification	rectangular	1.73	+/- 1.39
Acoustic noise	+/- 0.8	Specification	rectangular	1.73	+/- 1.39
Probe coil sensitivity	+/- 0.5	Specification	rectangular	1.73	+/- 0.87
Reference signal level	+/- 0.25	Specification	rectangular	1.73	+/- 0.43
Positioning accuracy	+/- 0.5	Standard deviation	Normal	1.00	+/- 0.50
Cable loss	+/- 1	Uncertainty	Normal	2.00	+/- 2.00
Frequency analyzer	+/- 0.3	Specification	rectangular	1.73	+/- 0.52
System repeatability	+/- 0.4	Standard deviation	Normal	1.00	+/- 0.40
Repeatability of the WD	+/- 0.3	Standard deviation	Normal	1.00	+/- 0.30
Combined standard uncertainty			Normal	1	0.83
Expanded uncertainty (coverage factor = 2) U			Normal (K=2)	2	1.65

12.0 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 T3 based on PC63.19-2001 rd 3.6

ANNEX A (Previously Filed RF Data)

RF Signal Strength Data were previously submitted to the FCC for this model (Report *FCC HAC rpt_i560_Rev B_050913*, dated 9/13/2005), which resulted in an updated grant with an M4 rating, per 47 CFR 20.19(b)(1). The summary data and scans are excerpted here from Section 9 of that report.

A.1 RF Test Results Summary (from Section 9).

iDEN 800MHz Band

Freq. (MHz)	Battery	Conducted Po (W)	E/H Field	Measured Field (V/m or A/m)	Appendix B Data (pg)	Excluded Cells	M-Rating
806.0125	SNN5705C	0.640	E	73.30	19	2, 3, 6	M-3
813.5125	SNN5705C	0.640	E	68.82	20	2, 3, 6	M-3
824.9875	SNN5705C	0.640	E	68.07	22	2, 3, 6	M-3
806.0125	SNN5705C	0.640	H	0.144	23	1, 2, 3	M-4
813.5125	SNN5705C	0.640	H	0.142	24	1, 2, 3	M-4
824.9875	SNN5705C	0.640	H	0.137	26	1, 2, 3	M-4

iDEN 900MHz Band

Freq. (MHz)	Battery	Conducted Po (W)	E/H Field	Measured Field (V/m or A/m)	Appendix B Data (pg)	Excluded Cells	M-Rating
896.0187	SNN5705C	0.640	E	52.34	27	1, 4, 7	M-4
898.5187	SNN5705C	0.640	E	54.72	28	1, 4, 7	M-4
900.9812	SNN5705C	0.640	E	55.63	29	1, 4, 7	M-4
896.0187	SNN5705C	0.640	H	0.141	30	1, 4, 7	M-4
898.5187	SNN5705C	0.640	H	0.139	31	1, 4, 7	M-4
900.9812	SNN5705C	0.640	H	0.131	32	1, 4, 7	M-4

A.2 RF Test Probe E-Field Scan Data (from Appendix A).

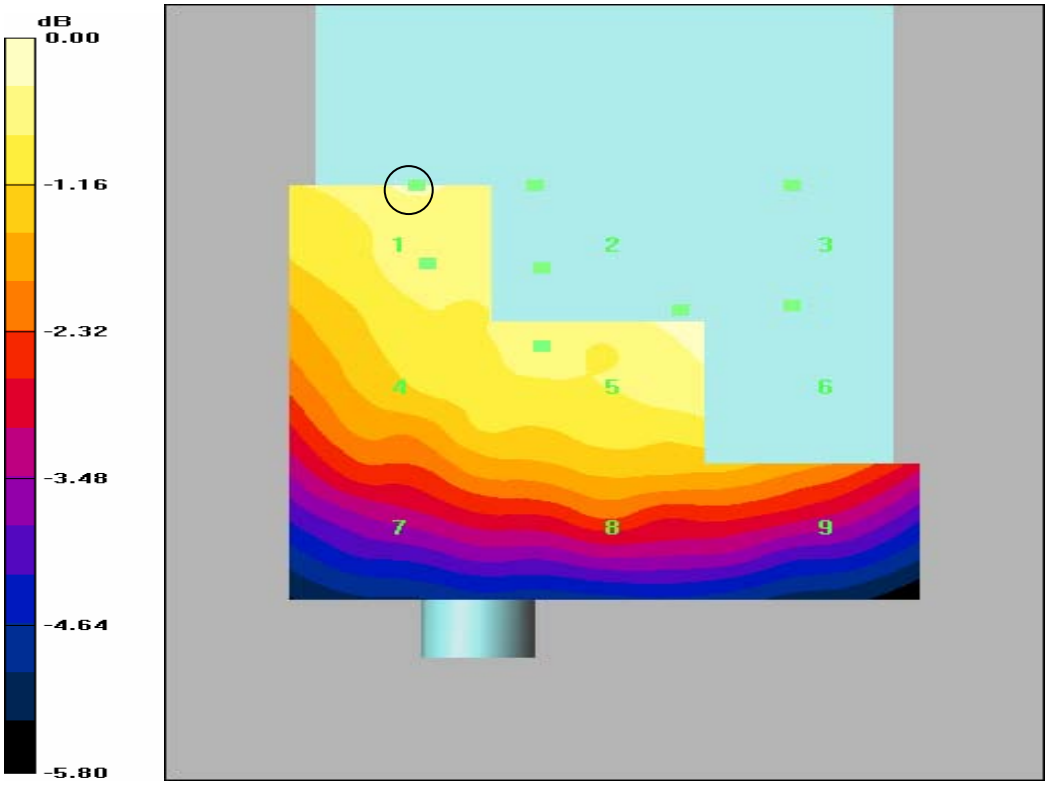
Motorola Corporate Florida Research Lab
iDEN i560 E-Field 800MHz band HAC assessment
Date: 7/14/05

SN 364KFG37GK
Frequency = 806MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: ER3DV6R - SN2246, Calibrated: 6/13/2005, ConvF(1, 1, 1)
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = -0.144dB

E in V/m (Time averaged)

Grid 1 **39.2**	Grid 2 **39.3**	Grid 3 **40.4**
Grid 4 **37**	Grid 5 **39.1**	Grid 6 **40.3**
Grid 7 **33.5**	Grid 8 **34.8**	Grid 9 **34.5**



A.3 RF Test Probe H-Field Scan Data (from Appendix A).

Motorola Corporate Florida Research Lab
iDEN i560 H-Field 800MHz band HAC assessment
Date: 7/14/05

SN 364KFG37GK
Frequency = 806MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: H3DV6 - SN6036, Calibrated: 1/7/2005,
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = -0.248 dB

H in A/m (Time averaged)

Grid 1 **0.11**	Grid 2 **0.098**	Grid 3 **0.097**
Grid 4 **0.08**	Grid 5 **0.073**	Grid 6 **0.07**
Grid 7 **0.062**	Grid 8 **0.058**	Grid 9 **0.056**