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 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 C63.19 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, and verified by the procedure stated in Section 6.5:

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

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 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

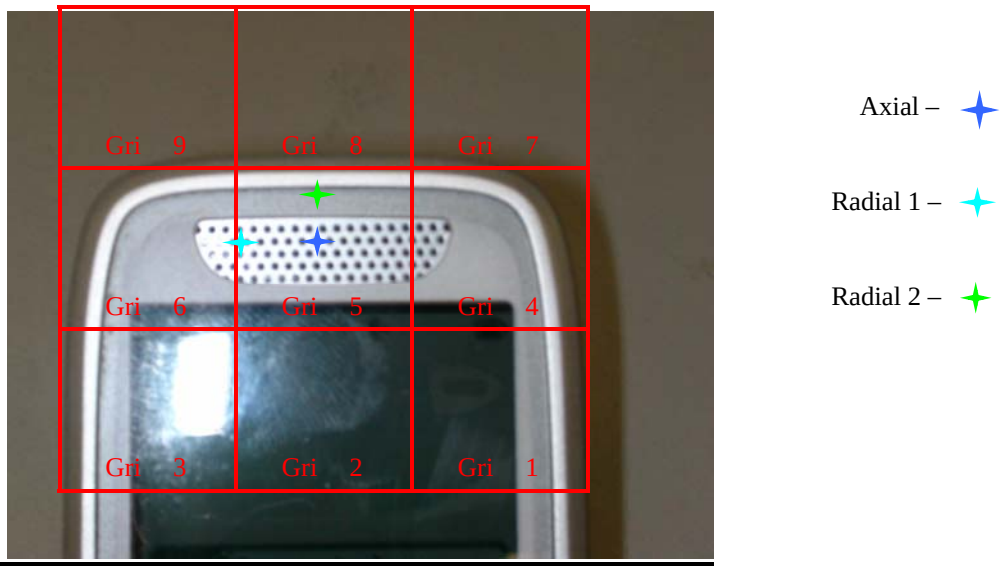


Figure 7-2 – Measurement Locations

Table 7 – Measurement location coordinates

Location	X coordinate (mm)	Y coordinate (mm)	Subgrid Number (See Appendix A)
Axial	0	0	5
Radial 1	-8	0	5
Radial 2	0	6.6	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 8 – Environmental Conditions

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

The Audio Laboratory's ambient and test system noise levels were 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.

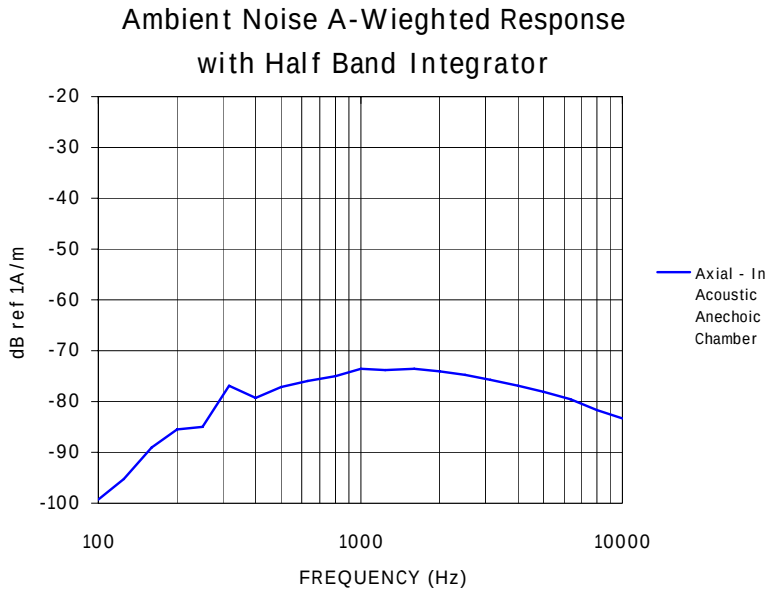


Figure 8-1– Axial Ambient Magnetic frequency distribution

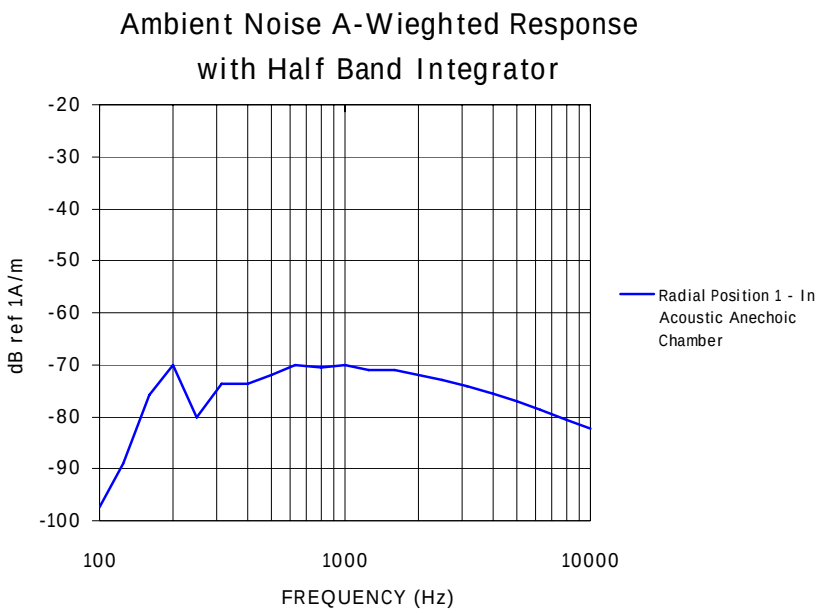


Figure 8-2 – Radial Position 1 Ambient Magnetic frequency distribution

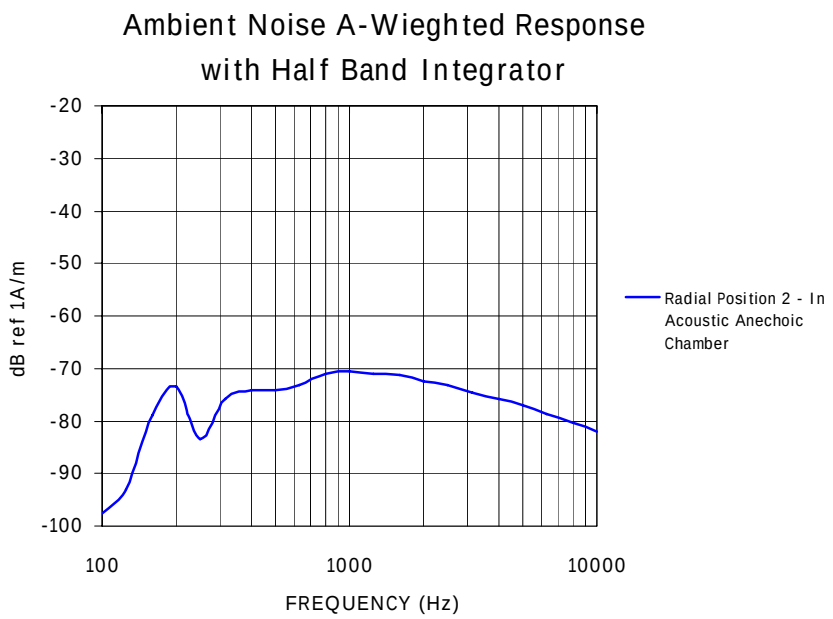


Figure 8-3 – Radial Position 2 Ambient Magnetic frequency distribution

9.0 Test Results Summary

The telecoil desired signal strength (ABM1) results per C63.19-2001 rd 3.6 section 6.3.4.2 are shown in Section 9.2 for the 800 MHz band and 9.4 for the 900 MHz band. The desired signal results are reported herein at the center of the 800 & 900 MHz bands only, as measured in a 1/3 octave bandwidth filter. The ABM1 frequency response plots for both 800 & 900MHz are shown in Section 9.1, and illustrate compliance with the C63.19 limits given in Section 2. Signal quality results depend on the undesired signal strengths (ABM2) measured per C63.19-2001 rd 3.6 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 and Figures 9-4-1 and 9-4-2 for the 900 MHz band. 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 numbers are in bold and highlighted in **Blue**. Signal to Noise ratios are reported in Section 9.3 for the 800 MHz band and 9.5 for the 900 MHz band. All measurements were made with backlighting off.

9.1 Axial frequency response plot data comparison:

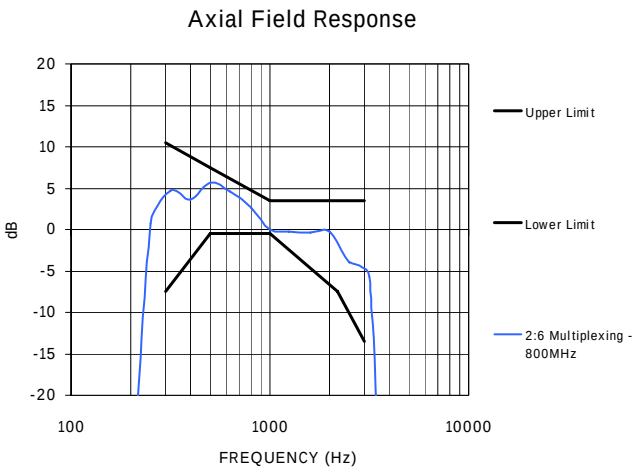


Figure 9-1-1 – 800 MHz Measured Frequency response

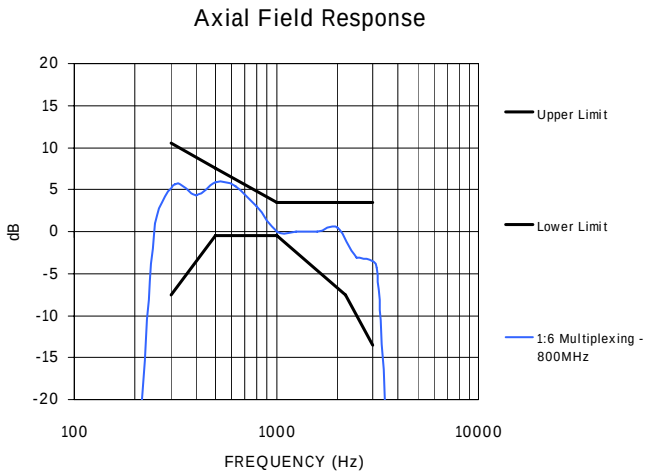


Figure 9-1-2 – 800 MHz Measured Frequency response

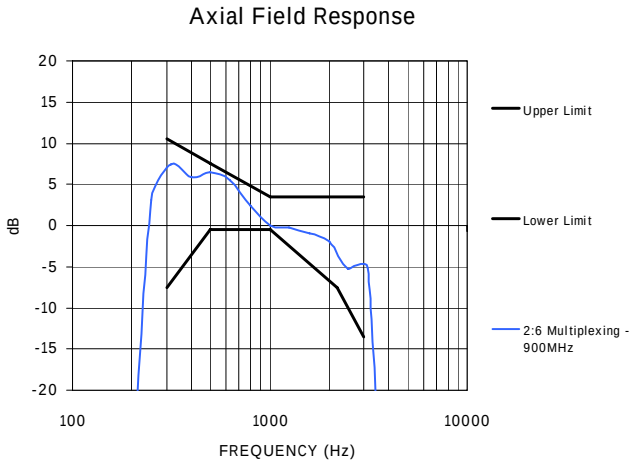


Figure 9-1-3 – 900 MHz Measured Frequency response

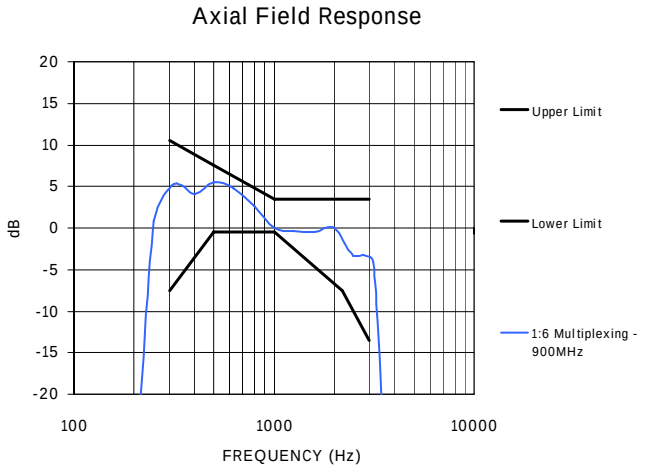


Figure 9-1-4 – 900 MHz Measured Frequency response

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 813.5125 MHz

Measurement Orientation with 2:6 multiplexing	Desired signal ABM1 (dB A/m)	Undesired Signal ABM2 (dB A/m)
Axial	6.94	-40.64
Radial 1	-6.79	-42.62
Radial 2	**-7.10**	-43.34

Measurement Orientation with 1:6 multiplexing	Desired signal ABM1 (dB A/m)	Undesired Signal ABM2 (dB A/m)
Axial	8.86	-46.48
Radial 1	-5.24	-45.09
Radial 2	-4.35	-46.70

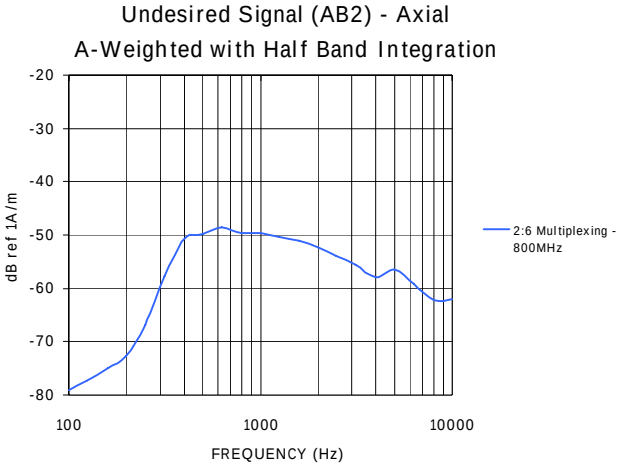


Figure 9-2-1 – 800 MHz Undesired Signal (2:6)

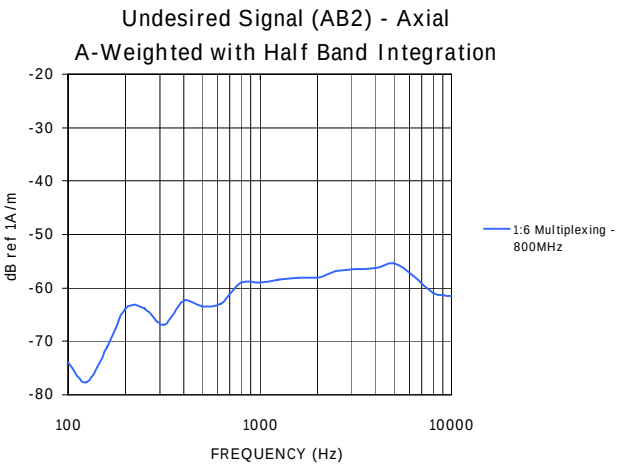


Figure 9-2-2 – 800 MHz Undesired Signal (1:6)

Considering that the user has no choice of multiplexing ratio (i.e. it is determined by the infrastructure) 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 two battery types listed on page 1 of this report.

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	47.58	55.34
Radial 1	**35.83**	39.85
Radial 2	36.24	42.35

9.4 900 MHz Band Audio band magnetic (ABM) signal strength measured at 900.9812 MHz

Measurement Orientation with 2:6 multiplexing	Desired signal ABM1 (dB A/m)	Undesired Signal ABM2 (dB A/m)
Axial	**6.47**	-40.67
Radial 1	-5.21	-43.45
Radial 2	-4.86	-43.58

Measurement Orientation with 1:6 multiplexing	Desired signal ABM1 (dB A/m)	Undesired Signal ABM2 (dB A/m)
Axial	9.95	-48.56
Radial 1	-4.77	-47.87
Radial 2	-3.69	-43.39

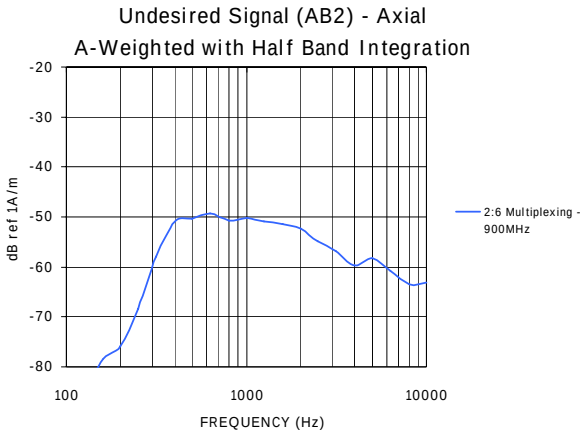


Figure 9-4-1 – 900 MHz Undesired Signal (2:6)

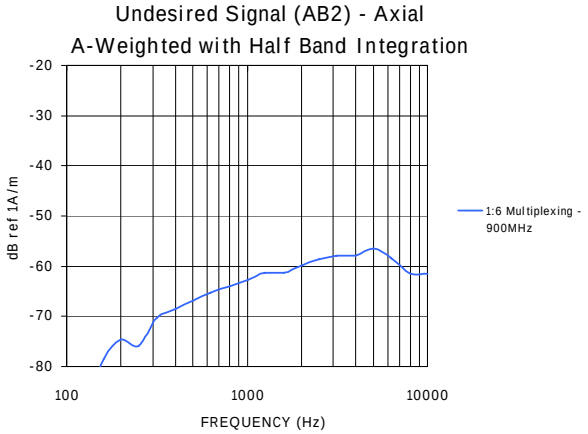


Figure 9-4-2 – 900 MHz Undesired Signal (1:6)

The ABM2 value reported was the highest value measured for the two 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	47.14	58.51
Radial 1	38.24	43.11
Radial 2	38.72	39.70

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: 6.47 dB A/m
Minimum radial: -7.10 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 2-2 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: 35.83 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 2-1 in section 2 a rating of M4 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 M4 at the specific locations where the telecoil measurements were made.

10.0 Category Rating Determination

The center of the telecoil inductive output field is concentric with the center of the acoustic output field so the RF interference field strength scan to determine the M-category rating may be used to determine the T-category rating. RF interference scan data for HAC compliance to justify an M4 rating was submitted previously for a class 2 permissive change. For convenience Annex A.3 herein contains 800 MHz E- and H-field plots which were extracted from that report. All of the telecoil inductive field measurement locations lie in sub-grid 5 (for exact locations see Table 7 in section 7).

In addition Annex A.1 herein contains RF interference field strength data summary tables extracted from section 9 of the cited report. It is evident in these tables that a M4 rating was justified in sub-grid 5 for all RF frequencies. Combined with the signal quality data summary in section 9.7 and Figure 2-2 this justifies a rating of M4 T4.

11.0 Uncertainty budget

Table 11 - 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 Compliance

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 M4 T4 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_i870_Rev O_050921,* dated 9/21/2005), 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 (Section 9 of the above referenced report).

Table 3 – 800 MHz Band

Freq.	Conducted Po (W)	E-Field (V/m)	Data Page	E-Field excluded cells	H-Field (A/m)	Data Page	H-Field excluded cells	M-Rating
806	0.640	43.62	19	1, 4, 7	0.105	23	1, 4, 7	M4
813.5	0.640	43.05	20	1, 2, 4	0.099	24	1, 4, 7	M4
821	0.640	42.68	21	1, 2, 4	0.097	25	1, 4, 7	M4
824	0.640	40.23	22	1, 2, 4	0.094	26	1, 4, 7	M4

Table 4 – 900 MHz Band

Freq.	Conducted Po (W)	E-Field (V/m)	Data Page	E-Field excluded cells	H-Field (A/m)	Data Page	H-Field excluded cells	M-Rating
896	0.640	30.91	27	1, 2, 3	0.090	30	1, 2, 3	M4
899	0.640	32.20	28	1, 2, 3	0.088	31	1, 2, 3	M4
901	0.640	22.08	29	1, 2, 3	0.065	32	1, 2, 3	M4

A.2 RF Test Probe Modulation Factors (Section 10 of the above referenced report).

Table 5 – Probe Modulation Factor (PMF) data

Probe Model-SN	MHz	Source	Field strength (V/m or A/m)	PMF
ER3DV6 R - 2246	**813.5**	**Handset**	**93.8**	**1.88**
ER3DV6 R - 2246	**813.5**	**E4432B/ AR Model SW1000**	**26.4**	
ER3DV6 R - 2246	**898.5**	**Handset**	**78.8**	**1.84**
ER3DV6 R - 2246	**898.5**	**E4432B/ AR Model SW1000**	**23.4**	
H3DV6 - 6036	**813.5**	**Handset**	**357**	**1.87**
H3DV6 - 6036	**813.5**	**E4432B/ AR Model SW1000**	**102**	
H3DV6 – 6036	**898.5**	**Handset**	**346**	**1.80**
H3DV6 – 6036	**898.5**	**E4432B/ AR Model SW1000**	**107**	

A.3 RF Test Probe E-Field Scan Data (Appendix A of the above referenced report).

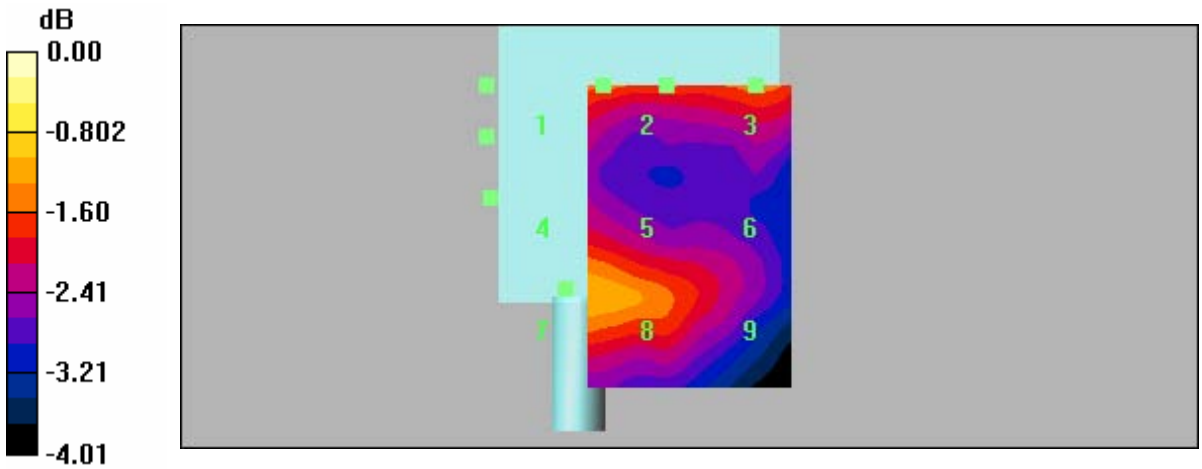
iDEN i870 E-Field 800MHz band HAC assessment
(excerpted from page 19 of HAC report dated 9/21/05)

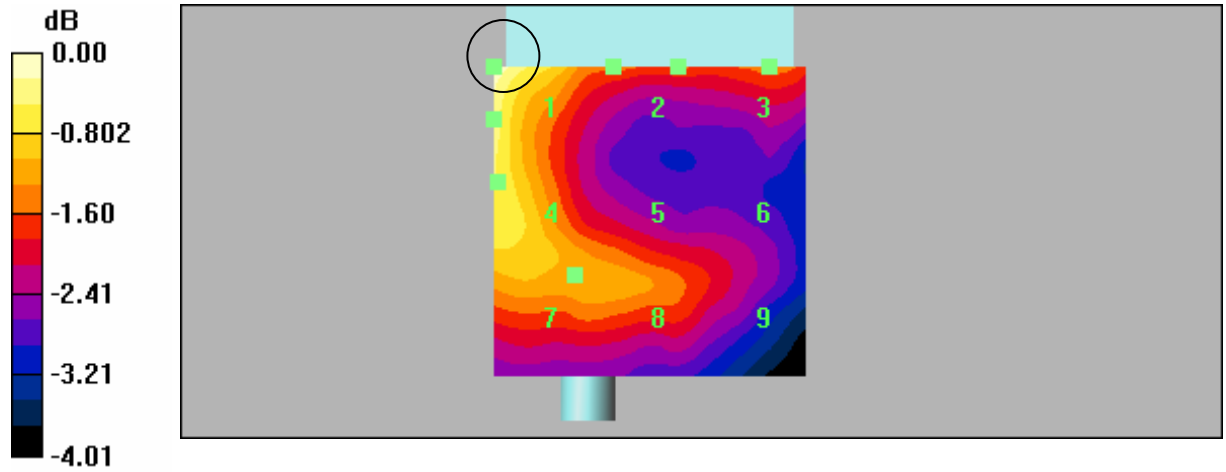
SN 364YFQ86X1
Frequency = 806MHz
TX Pwr = 640mW

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 = -0.071dB

E in V/m (Time averaged)

Grid 1 **26.5**	Grid 2 **22.4**	Grid 3 **22.5**
Grid 4 **25**	Grid 5 **23.1**	Grid 6 **21.4**
Grid 7 **23.6**	Grid 8 **23.2**	Grid 9 **21.6**





A.4 RF Test Probe H-Field Scan Data (Appendix A of the above referenced report).

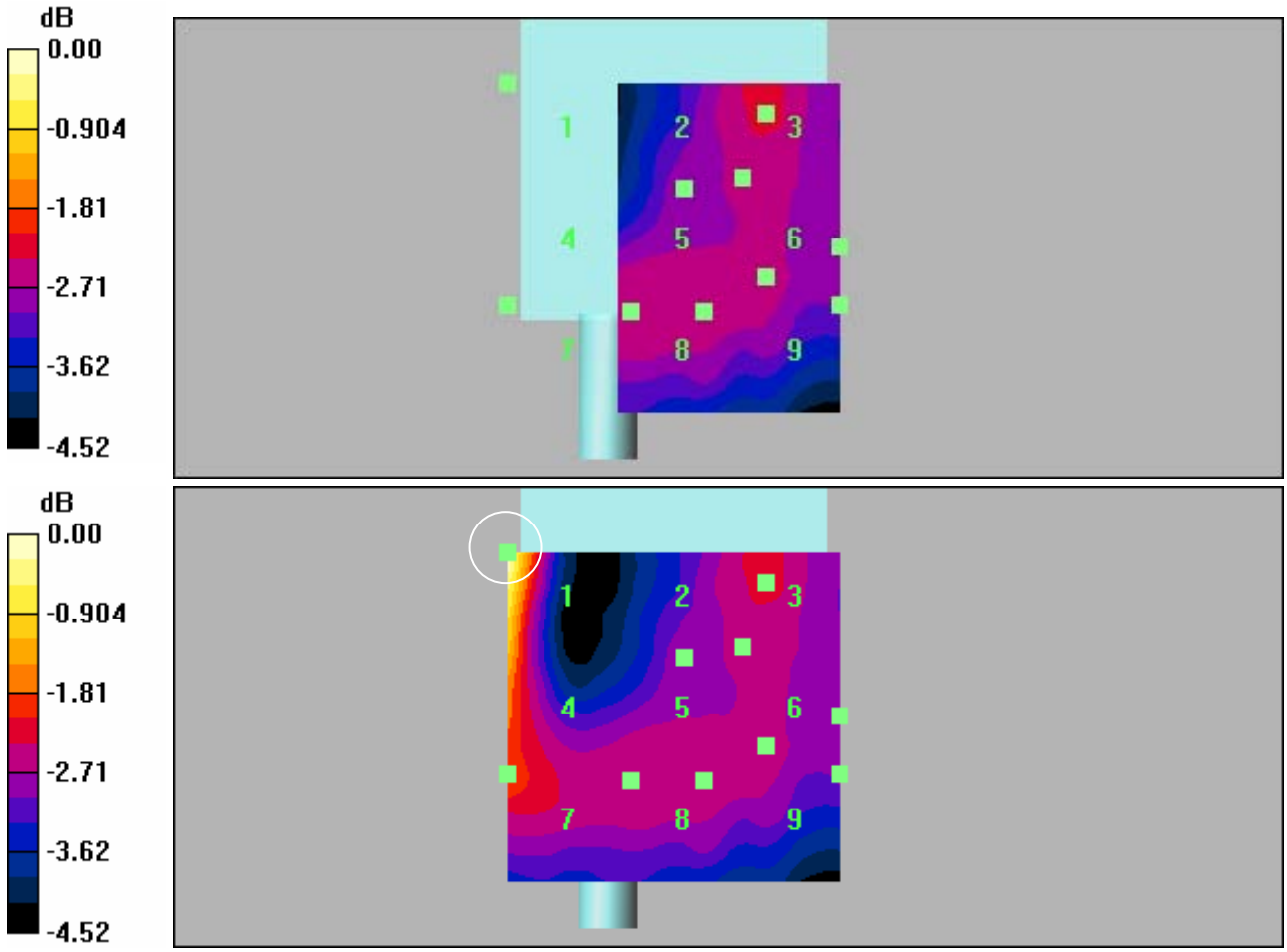
iDEN i870 H-Field 800MHz band HAC assessment
(excerpted from page 23 of HAC report dated 9/21/05)

SN 364YFQ86X1
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 = -0.432 dB

H in A/m (Time averaged)

Grid 1 **0.073**	Grid 2 **0.054**	Grid 3 **0.056**
Grid 4 **0.063**	Grid 5 **0.055**	Grid 6 **0.055**
Grid 7 **0.059**	Grid 8 **0.055**	Grid 9 **0.055**



ANNEX B (Manufacturer's Probe Calibration Certificates)

Communication Certification Laboratory

HAC Probe Certificate of Calibration

Client: Motorola Inc.
Test No: 63-0284
Model No: R-100
Serial No: 0238
Description: HAC Probe (Radial)

Job Number/Certificate No. 1048
Test Program:
Test Program Revision: None
Laboratory Site No: 1

At the time of calibration, this certifies that the above product was calibrated in accordance with applicable Communication Certification Laboratory (CCL) procedures. This report is not to be reproduced, except in full, without written approval of CCL.

At planned intervals, CCL measurement standards are calibrated by comparison to or measurement against national standards, natural physical constants, or consensus standards.

National Standards are administered by NIST (National Institute of Standards and Technology) or other recognized national standards laboratories.

Initial testing found this instrument WITHIN SPECIFICATION. The measurement uncertainty is ±0.13 dB.

Support documentation relative to traceability is on file and is available for examination upon request.

CCL recommends calibration of this equipment in the interval of 1 year and the calibration due date based on this interval is one year from the calibration date.

Standards Used

ID No.	Model No.	Manufacturer	Serial No.	Calibrated
552	HP3585	Hewlett Packard	---	2005-07-11
534	Signal Power Bench	CCL		2005-12-07
1030	CCL Helmholtz Coil per IEEE Standard 1027 Appendix C			

Temperature: 73° F Relative Humidity: 20% Barometric Pressure: 30.48

Calibration Date: May 1, 2006

Calibration Technician

Corporate Office and Laboratory
1940 West Alexander Street Salt Lake City, Utah 84119-2039
Tel (801) 972-6146 Fax (801) 972-8432

www.cclab.com

EMC Open Area Test Site
500 West Wanship Road Wanship, Utah 84017-9760
Tel (435) 336-5868 Fax (435) 336-2785

Communication Certification Laboratory

HEARING AID PROBE CALIBRATION

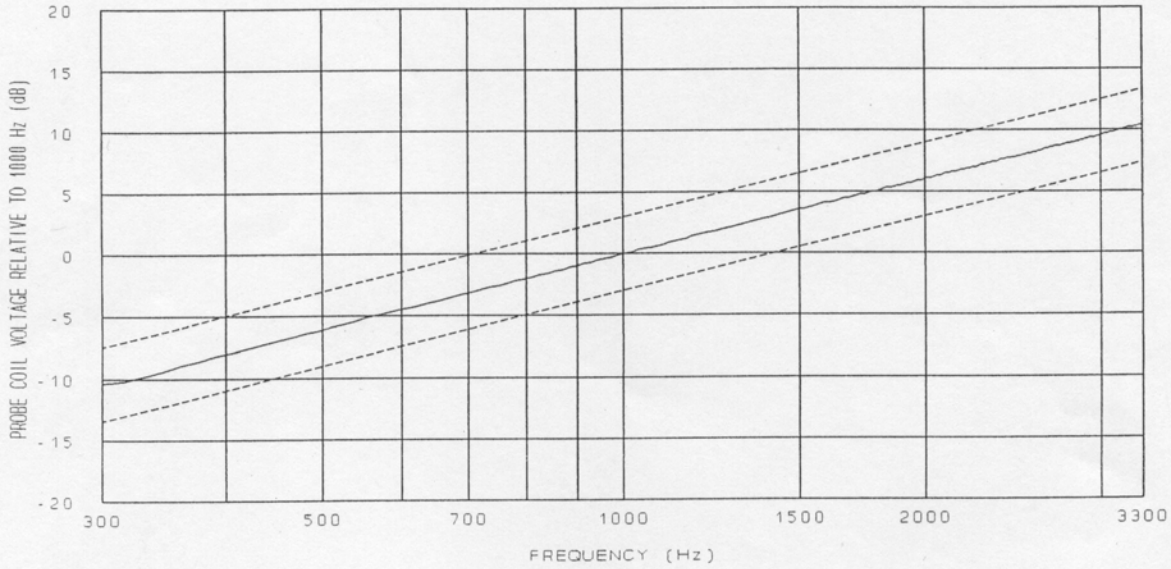
Model Number: R-100 Data Form: P1

Serial Number: 0238

Specification Reference: IEEE Standard 1027, Sections 5.1 and 5.2

Sensitivity at 1000 Hz: -60.1 dBV/(A/m)

Frequency Response:



* Dashed lines indicate 6 dB / octave slope.
** The Measurement Uncertainty of the probe is ±0.13 dB.

Comments:
Bench: [x] BC:000534 Signal Power A

Test Operator: JD Date: May 1, 2006

Communication Certification Laboratory

HAC Probe Certificate of Calibration

Client:	Motorola Inc.	Job Number/Certificate No. 1049	
Test No:	63-0284	Test Program:	
Model No:	A-100	Test Program Revision: None	
Serial No:	0238	Laboratory Site No: 1	
Description:	HAC Probe (Axial)		

At the time of calibration, this certifies that the above product was calibrated in accordance with applicable Communication Certification Laboratory (CCL) procedures. This report is not to be reproduced, except in full, without written approval of CCL.

At planned intervals, CCL measurement standards are calibrated by comparison to or measurement against national standards, natural physical constants, or consensus standards.

National Standards are administered by NIST (National Institute of Standards and Technology) or other recognized national standards laboratories.

Initial testing found this instrument WITHIN SPECIFICATION. The measurement uncertainty is ±0.13 dB.

Support documentation relative to traceability is on file and is available for examination upon request.

CCL recommends calibration of this equipment in the interval of 1 year and the calibration due date based on this interval is one year from the calibration date.

Standards Used

ID No.	Model No.	Manufacturer	Serial No.	Calibrated
552	HP3585	Hewlett Packard	---	2005-07-11
534	Signal Power Bench	CCL		2005-08-07
1030	CCL Helmholtz Coil per IEEE Standard 1027 Appendix C			

Temperature: 73° F Relative Humidity: 20% Barometric Pressure: 30.48

Calibration Date: May 1, 2006

Calibration Technician

Corporate Office and Laboratory
1940 West Alexander Street Salt Lake City, Utah 84119-2039
Tel (801) 972-6146 Fax (801) 972-8432

www.cclab.com

EMC Open Area Test Site
500 West Wanship Road Wanship, Utah 84017-9760
Tel (435) 336-5868 Fax (435) 336-2785

Communication Certification Laboratory

HEARING AID PROBE CALIBRATION

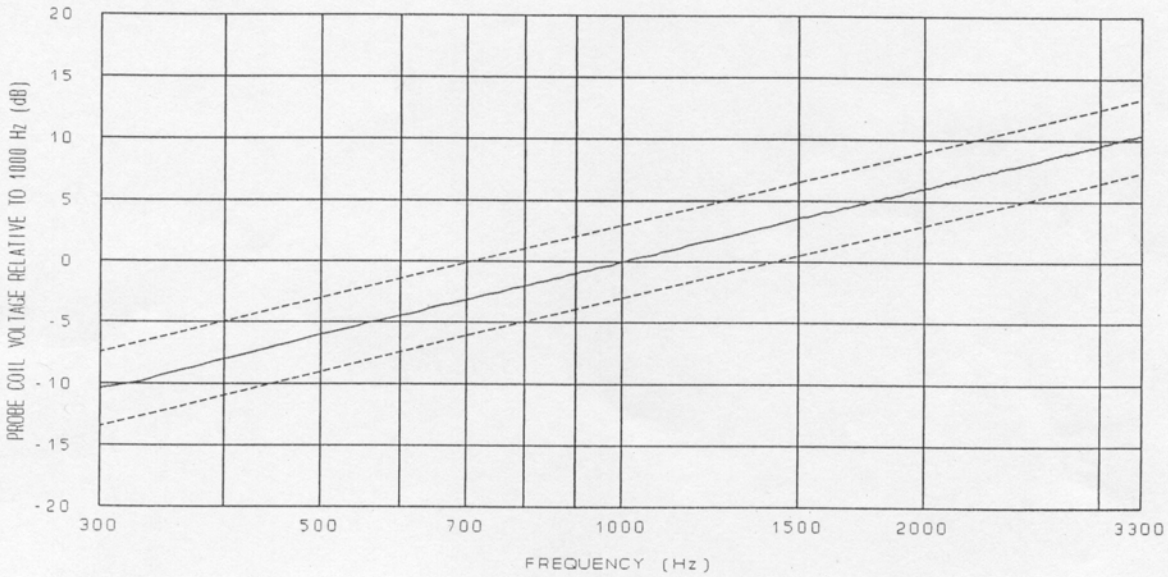
Model Number: A-100 Data Form: P1

Serial Number: 0238

Specification Reference: IEEE Standard 1027, Sections 5.1 and 5.2

Sensitivity at 1000 Hz: -60.1 dBV/(A/m)

Frequency Response:



* Dashed lines indicate 6 dB / octave slope.
** The Measurement Uncertainty of the probe is ±0.13 dB.

Comments:
Bench: [x] BC:000534 Signal Power A

Test Operator: JD Date: May 1, 2006