Hearing Aid Compatibility Audio Band Magnetic (ABM) T-Coil Test Report

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Statement of Compliance: RIM Testing Services (RTS) declares that the product was tested in accordance with the appropriate measurement standards, guidelines and recommended practices.

This Blackberry® Smartphone is a wireless portable device and has been shown to be in compliance with FCC 20.19 (10-1-07 Edition), Hearing Aid-Compatible Mobile Handsets, FCC Public Notice DA 06-1215 (June 6, 2006) and FCC Report and Order (Feb. 28, 2008).

	Signatures	Date
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1.0 Introduction

This test report demonstrates measurement of the Audio Band Magnetic fields (ABM) generated by a wireless communication device in the region where a hearing aid would be used in the T-Coil mode.

Three quantities are measured and evaluated. The first is the field intensity of the desired signal at the center of the audio band. The second is the frequency response of the desired signal measured across the audio band. The third is the signal quality, which is defined as the ratio between the desired and undesired magnetic field levels.

The SPEAG DASY4 T-Coil extension together with the HAC RF extension 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. Using DASY4, three orthogonal axes are scanned with a probe incorporating a sensor coil: one axial (perpendicular), and two radial (transverse and longitudinal) directions with respect to the plane and main axis of the WD.

The WD is mounted on the Test Arch phantom (provided with the HAC RF extension). Its acoustic center is centered and represents the reference for the combination of ABM and RF field evaluation. The ABM fields of the WD (frequency range <20 kHz) are scanned with a fully RF shielded active 1D magnetic probe. The probe axis is oriented in space diagonal to the three orthogonal axes, and its single sensor can be oriented to the axes by 120° rotation. The probe signal is evaluated by an Audio Magnetic Measurement Instrument (AMMI) which is interfaced to the DASY4 computer via USB. The AMMI also provides test and calibration signals and interfaces to the Helmholtz Audio Magnetic Calibration Coil (AMCC).

Predefined or user-definable audio signals for injection into the WD during the test are available at a connector of the AMMI. The DASY4 software allows flexible control of scan, rotation, measurement duration, as well as selection of the measurement mode and signal source for all ABM measurements. Filtering as specified by the standard is applied to the sampled signal resulting in the signal level, (weighted) noise level and a third-octave resolution spectrum for the frequency response. This information is represented numerically and graphically during the scans and graphically evaluated in the postprocessor. The combination of the quantities (signal level, frequency response, signal to noise ratio) leads to an overall classification according to ANSI-C63.19. Coarse, fine and point scan together with user selectable test signals, minimize the time to find the “optimal point” with the highest class for the WD.

For each probe orientation, the background noise is measured for each probe orientation without an active WD in the area of the WD scan and should be < 10 dB than the lowest ABM2 measurement, where applicable.

2.0 Applicable references

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

[2] FCC 47CFR § 20.19 (10-1-07 Edition), Hearing Aid-Compatible Mobile Handsets

[3] FCC Public Notice DA 06-1215 (June 6, 2006)

[4] SPEAG DASY4 V4.7 user manual, June 2006

[5] Hearing Aid Compatibility: RF Emissions Measurements TCB Review Guidance, 12 May 2005

[6] FCC Hearing Aid Compatibility Guidance, Oct. 2006

[7] FCC Report and Order, Feb. 2008

3.0 Equipment unit tested

3.1 Picture of device

Please refer to Annex E.

Figure 1: BlackBerry smartphone

3.2 Device description

Device Model	RBY41GW				
FCC ID	L6ARBY40GW				
PIN Number	20746462 (HAC RF); 20746573 (HAC T-Coil)				
Prototype or Production Unit	Production				
Mode(s) of Operation	GSM 850	GSM 1900	* Bluetooth	** 802.11b	** 802.11g
Nominal Maximum conducted RF Output Power (dBm)	32.5	30.5	2.67	18.00	17.00
Tolerance in Power Setting on centre channel (dB)	± 0.50	± 0.50	N/A	± 0.50	± 0.50
Duty Cycle	1:8	1:8	N/A	1:1	1:1
Transmitting Frequency Range (MHz)	824.2 – 848.8	1850.2 – 1909.8	2402-2483	2412-2462	2412-2462

Table 1. Test device characterization

* Bluetooth technology does not support voice application and simulateous transmission has been exempted based on sum of 1g SAR values < 1.6 W/kg for all transmitters. Therefore, HAC RF Emission or Audio Band Magnetic (ABM) T-Coil testing are not applicable to Bluetooth.

** WLAN 802.11 b/g bands were not evaluated for HAC RF compliance since there is no defined test procedure in the ANSI C63.19 standard or FCC guidance.

BT and WiFi are not activated during test because they are not held-to-ear services.

3.3 Antenna description

Type	Internal fixed antenna
Location	Bottom back centre
Configuration	Internal fixed antenna

Table 2. Antenna description

4.0 List of test equipment

Manufacturer	Test Equipment	Model Number	Serial Number	Calibration Due Date
SCHMID & Partner Engineering AG	Data Acquisition Electronics (DAE3)	DAE3 V1	472	03/05/2008
SCHMID & Partner Engineering AG	Audio Band Magnetic Probe	AM1DV2	1016	04/16/2009
SCHMID & Partner Engineering AG	Helmholtz Coil AMCC	N/A	1021	CNR
SCHMID & Partner Engineering AG	Audio Band Magnetic Measuring Instrument (AMMI)	N/A	1013	CNR
Rohde & Schwarz	Base Station Simulator	CMU 200	109747	12/04/2008
Rohde & Schwarz	Telephone Magneitc Field Simulator	TMFS	1003	01/28/2010

Table 3. List of test equipment

5.0 DASY4 HAC T-Coil measurement system and setup

5.1 Audio signals:

The following audio signal files are used for calibration and measurements:

1.025 kHz sinewave (duration 10 s): used alternatively instead of 1 kHz, according to [1] 6.3.1 step 2, if the internal 1.0 kHz signal would cause interferences inside the WD. The bandwidth is suited for signal quality or signal level measurements.

Multisine signal 50 Hz – 5 kHz (duration 10 s): Signal with carrier centered in each third-octave band, as used during the calibration.

48k_voice_300-3000 (duration 2 s): The signal is voice like and has been processed to have a duration of 2 seconds for fast measurement. The bandwidth is suited for frequency response measurement.

Signal type	***1.025 kHz sinewave***	***48k_voice_300-3000***
Signal length (s)	10	2
Time per location for ABM1, ABM2 and input level measurement (s)	2	2
Averaging over signal repetitions	1	1

Table 4: Audio files length and averaging times

5.2 Input level measurement

To determine correct input level, the Encoder / Decoder of a Rohde & Schwarz CMU 200 base station simulator was calibrated for measured full-scale input voltage level. From the measured full-scale voltage level, the equivalent input voltage level of -16 dBm0 was calculated as shown below:

Decoder: When an acoustic signal is provided to the microphone of the device under test it travels through the device audio path and then over the air to the CMU. At the CMU this digital signal is Decoder and an analog voltage is generated at the CMU output. This voltage is measured and related to the dBm0 level according to the Decoder calibration. The calibration of the CMU Decoder provides the relationship between the voltage generated and the dBm0 level. When the CMU Decoder CAL is selected the CMU generates a voltage equivalent to the full-scale value (3.14 dBm0). Measuring this voltage provides the Decoder calibration. The Decoder calibration was determined to be 3.49 dB.

Encoder: When a voltage signal is provided to the CMU, it is Encoded and sent over the air to the device under test. Once it reaches the device it travels through the device audio path to either the receiver (earpiece for handset mode) or the loudspeaker (for handsfree or speakerphone mode). The calibration procedure for the CMU Encoder involves determining the gain/loss in the Encoder and the signal required to produce a full-scale digital signal. The calibration of the CMU Encoder is slightly more complicated than for the Decoder because during calibration (Encoder CAL) the input signal to the CMU Encoder travels back through the Decoder so the Decoder calibration must be taken into account in the calculation procedure – a signal is input to the CMU Encoder and goes through the CMU Decoder and back out again. The calibration is determined from the level of the input signal and the output signal and knowing the previously determined Decoder calibration level. The voltage required to produce a full-scale signal for the CMU200 SN: 109747 was determined to be 1054 mV.

Once calibration is complete, required voltage can be calculated to produce a desired dBm0 level for the device under test.

$Z = Y - (3.14 - X)$

Where:

Z = signal required into CMU (dBV)
Y = desired dBm0 level (-16 dBm0 for GSM HAC T-coil testing)
X = full-scale calibration value (dBV)

Example:
Y = -16 dBm0
X = 1054 mV = 0.46 dBV
Therefore, Z = -16 - (3.14 - 0.46) = - 18.68 dBV (116 mV)

For this particular CMU200 SN: 109747 an input voltage of 116 mV will generate a -16 dBm0 signal.

Time averaging was used with an artificial speech based signal when setting the input reference level. The averaging period was adequate to cover the signal period and the averaging method was the same for setting the reference level and performing the measurement.

5.3 Bandwidth compensation

ABM1 values and deduced quantities (SNR and frequency response scaling) are based on the measured field in the 1 kHz third-octave filter. Bandwidth compensated values are available under the following conditions:

- A reference measurement with the same signal type is available (T-Coil job marked with "use as
reference") before the job to be compensated.
- The reference measurement is taken in the AMCC (z orientation), evaluating the coil signal.
- The reference measurement precedes the job within the same procedure.
- Before displaying the desired value based on the measured ABM1 value, a pop-up window appears, proposing a default value based on the reference measurement.

The proposed value is calculated as the ratio of (power sum of third-octave filters from 100 Hz to 5 kHz) / (ABM1 in 1 kHz third-octave filter). This factor leads to the "ABM1 bandwidth compensated" which is an estimation of the signal level of a narrowband ABM1 signal with the same input amplitude. The estimated value may however differ from a measurement with a narrowband signal due to nonlinearity effects or contribution of noise and interference available during the reference measurement.

If an input signal is completely within the 1 kHz third-octave band is used (narrow band signal), no compensation is required. If the test signal contains spectral components in other third-octave bands, the power in the 1 kHz subband is lower for the same overall power, and the reading from the 1 kHz band is consequently reduced. This reduction shall be compensated to give the equivalent reading as when using a narrowband signal. The reduction - when using a wideband signal with the same overall RMS power - is the ratio between the overall RMS power and the RMS power in the 1 kHz band. For signal with limited bandwidth (e.g. from 300 Hz to 3 kHz), the power is determined by summing up their contribution in all third-octave subbands. The correction is the ratio "sum power / 1 kHz power" (linear) or the equivalent value in dB (20 * log (Vrms total / Vrms 1k)).

For 1025 Hz, the proposed factor is very close to 0 dB (linear 1), because the signal is completely within the 1 kHz subband. Small deviations may occur due to noise during the reference measurement, or due to other spectral components. Differences between the narrowband and the voice signal test: ABM1 (without BWC) for the same RMS reading is smaller for the wideband (voice) signal compared to the narrowband signal by the BWC. For the "***48k_voice_300-3000 (duration 2 s)"*** predefined signals, the difference is provided by SPEAG to be 10.8 dB.

During the reference measurement, the spectral distribution of the input signal is determined. A spectral distribution results which is equivalent to the input distribution plus the response of the WD. To determine the response of the WD, the spectrum from the WD is deducted. The response is then compared to the limits, which are level dependent (based on the ABM1 signal level). For the display, the spectrum is displayed with the BWC applied.

5.4 Vocoder type

The following vocoders were evaluated and the results are shown on Table 11.

Full Rate Version 1
Full Rate Version 2 (best quality)
Half Rate Version 1
Full Rate AMR
Half Rate AMR

5.6 Phantom

Figure 2 shows the phantom setup in a DASY4 system. The AMCC is mounted on the same plane as the HAC Test Arch phantom available from the HAC RF extension.

5.7 AMCC

The Audio Magnetic Calibration Coil is a Helmholtz Coil designed according to [1], section D.9 for calibration of the AM1D probe. The two horizontal coils generate a homogeneous magnetic field in the z direction.

Shunt sensitivity Hc = 1 A/m per 100mV according to formula:

Hc = (U / R) * N / r / (1.25 ^ 1.5)

Number of turns N = 20 per coil
Coil radius r = 143 mm
Shunt resistance R = 10.00 Ohm

Please refer to the certificate of conformity doc No 880-SD HAC P02 A-A in Annex D for more detail.

5.8 AM1D probe

The AM1D probe is an active probe with a single sensor according to [1] section D.8. It is fully RF shielded and has a rounded tip of 6 mm diameter incorporating a pickup coil with its center offset 3mm from the tip and the sides.

SPEAG, the manufacturer of the T-Coil system tested the probe frequency response and its dynamic range. Compliance with [1] is stated in the Certificate of conformity document 880-SPAM1001A-A. Also the probe frequency has been verified and the response deviation from the ideal differentiator was within +0.05 and - 0.46 dB in the range 100 Hz to 10 kHz on the center frequencies of the third-octave bands. Note that this verification includes the probe preamplifier and the AMMI internal preamplifiers, filters and processing.

Frequency response:
The frequency response has been tested to be within +/- 0.5 dB of ideal differentiator from 100 Hz to 10 kHz. The test was performed with the real integrator and deducting the ideal integrator values. The reference signal was the Helmholtz calibration coil current which is equivalent to the field. The coil is qualified according to the probe manufacturer certificate.

The test data up to 5 kHz are visible directly in the calibration job result (coil current / shut voltage and probe voltage). Separate measurements were made for a very wide frequency range, including higher frequencies. The third-octave bands up to 5 kHz do not exceed + 0.05 dB and decay by < 0.2 dB to 5 kHz and by < 0.5 dB to 10 kHz , as required.

Dynamic range:
maximum + 21 dB A/m @ 1 kHz
Noise level typically -70 dB A/m @ 1 kHz
ABM2 typically -60 dB A/m

Linearity
Within < 0.1 dB from 5 dB
below limitation to 16 dB above noise level

Linearity has also been tested and is stated in the certificate. Deviation was not measurable from 5 dB below limitation to 26 dB above noise level. For lower levels, the deviation increased to 0.1 dB at 16 dB above noise level, which corresponds to the theoretical value of 0.11 dB expected at that noise suppression level.

Significant noise contribution beyond 10 kHz will be attenuated by the convolution A-filter. Such interferences also contribute to ABM2 represented as numerical value from the integration.

Sensitivity
Typically -24 dBV / A/m @ 1 kHz probe output

For detailed T-Coil probe's dynamic range, linearity and frequency response demonstration, the manufacturer has supplied a report directly to the FCC which is not intended for publication.

Figure 2: T-Coil set up with HAC Test Arch with Helmholtz Coil (AMCC)

5.9 AMMI

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

Audio Out BNC, audio signal to the base station simulator, for > 500 Ohm load
Coil Out BNC, test and calibration signal to the AMCC (top connector), for 50 Ohm load
Coil In XLR, monitor signal from the AMCC BNO connector, 600 Ohm
Probe In XLR, probe signal and phantom supply to the probe connector

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Figure 3: The Audio band Magnetic field Measuring Instrument (AMMI)

5.10 Cabling

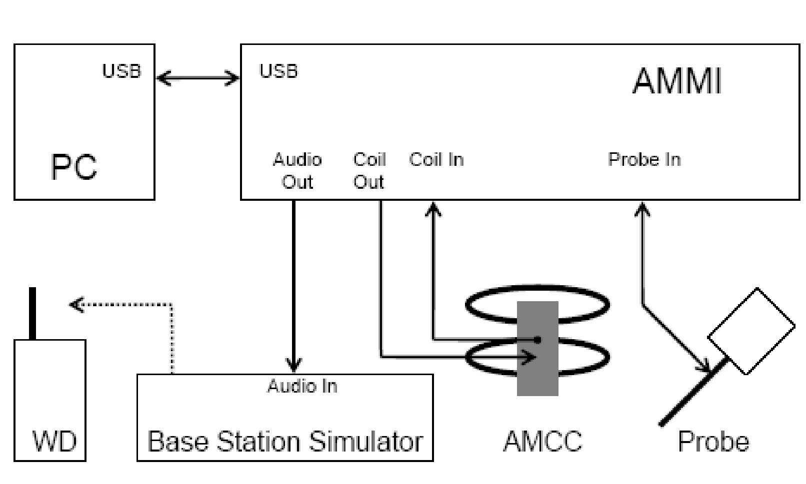


Figure 4: T-Coil set up cabling

6.0 Measurement procedures

6.1 Surface check and probe sensitivity measurements

***Calibrate HAC phantom**:* After teaching of the reference points P1, P2 and P3 of the HAC Test Arch and installation of a WD below the Test Arch, the plane defined by the 3 points may correspond to the top plane of the Test Arch. This option of the Surface Check job measures the mechanical surface with the probe in vertical position, using all 4 points and determines the optimal plane for all the following measurements. The coordinate system of the whole setup is adjusted to the resulting plane.

Calibrate AM1D probe: This option allows the adjustment of the sensor center of the AM1D probe accurately at the desired measurement point. In Southwest tilting mode, the probe center should be aligned to the position 3.0mm above point P1 by shifting the x, y and z coordinates. The probe surface is in this situation directly located at the center of point P1. The offset resulting from this teaching process is stored in the installation of the phantom for further use with the same configuration.

Calibration
If the “Calibration” signal is selected in the T-Coil measurement job, a 3-phase calibration is performed.

In phase 1, the audio output is switched off, and a 200 mV_pp symmetric rectangular signal of 1 kHz is generated and internally connected directly to both channels of the sampling unit (coil in, probe in).

In phase 2, the audio output is off, and a 20 mV_pp symmetric 100 Hz signal is internally connected.

The signals during these phases are available at the output on the rear panel of the AMMI. The output must however not be loaded in order not to influence the calibration. After the first two phases, the two input channels are both calibrated for absolute measurements. The resulting factors are displayed above the multimeter window.

In phase 3, a multisine signal covering each third-octave band from 50 Hz to 5 kHz is generated and applied to both audio outputs. The probe should be positioned in the center of the AMCC (user point “coil center”) and aligned in the z-direction, the field orientation of the AMCC. The Coil In channel is measuring the voltage over the AMCC internal shunt, which is proportional to the magnetic field in the AMCC. At the same time, the Probe In channel samples the amplified signal picked up by the probe coil. The ratio of the two voltages – in each third-octave filter

Leads to the calibration factor of the probe over the frequency band of interest for the spectral representation.

The typical representation of the calibration result in the DASY window is shown in Figure 5: The internal calibration factors of the coil and probe channel are listed.

The graphics represent the values (applying the calibration factors from the previous steps) for the probe and coil channel in dB V for each third-octave filter from 100 Hz to 5 kHz.

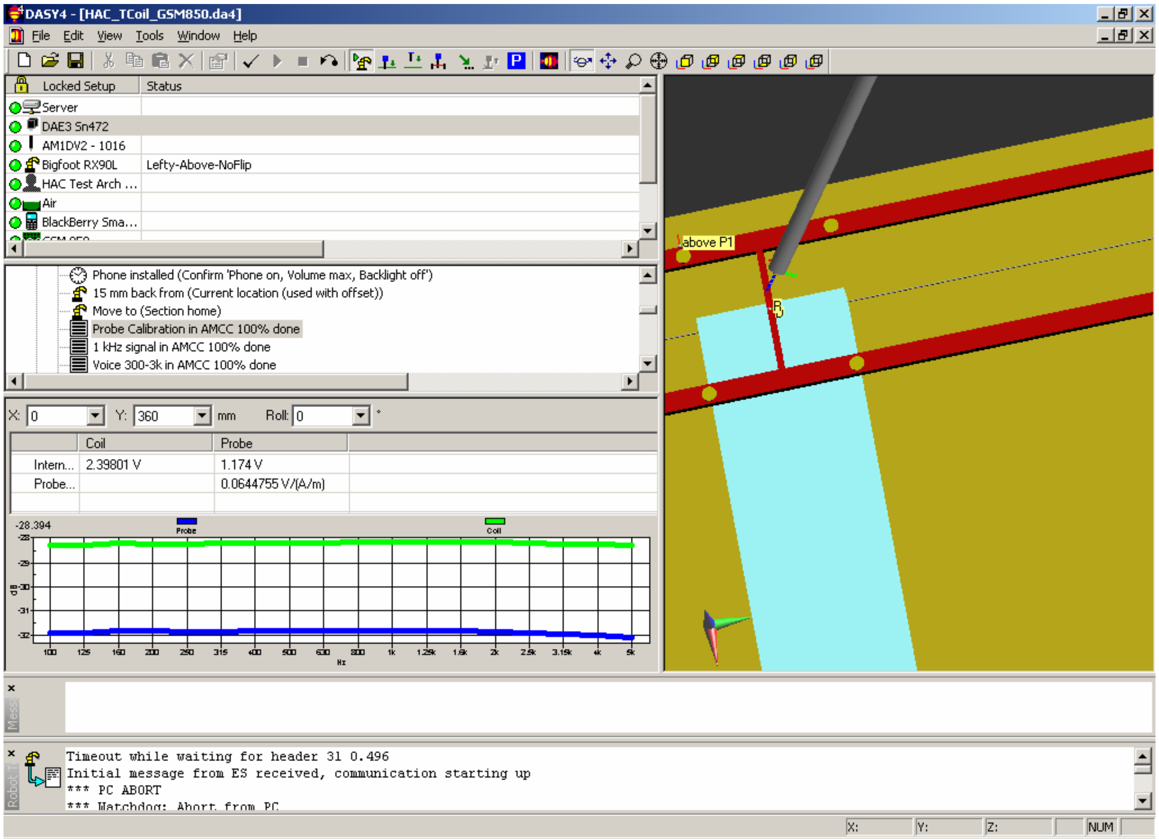


Figure 5. DASY4 ABM probe calibration

The measured probe sensitivity, target and delta values are shown below:

Measured probe sensivity V / (A/m)	Target manufacturer probe sensivity V / (A/m)	Delta (%)
0.0645	0.0657	-1.83

Table 5: Measured probe sensitivity value

6.2 Audio band magnetic ambient noise measurement

For each probe orientation, the background noise was measured without an active WD in the area of the scan and the noise was determined to be < 10 dB than the lowest ABM2 measurement as shown on Table 11, where applicable.

6.3 Reference check/system validation using a TMFS

A reference check of the test setup and instrumentation was performed using a reference TMFS (Telephone Magnetic Field Simulator).

The TMFS was positioned into the test setup at the position to be occupied by the WD. The emissions from the TMFS were measured and confirmed to be within tolerance of the expected values.

Distance TMFS top-probe centre	10 mm
Scan resolution dx, dy	5 mm
Scan area	50 x 50 mm
Frequency	1 KHz
Signal level to TMFS for field scan	500 mV rms
Signal type for field scan	1 KHz sine
Signal type for frequency reponse	Multisine signal 50-5000 Hz

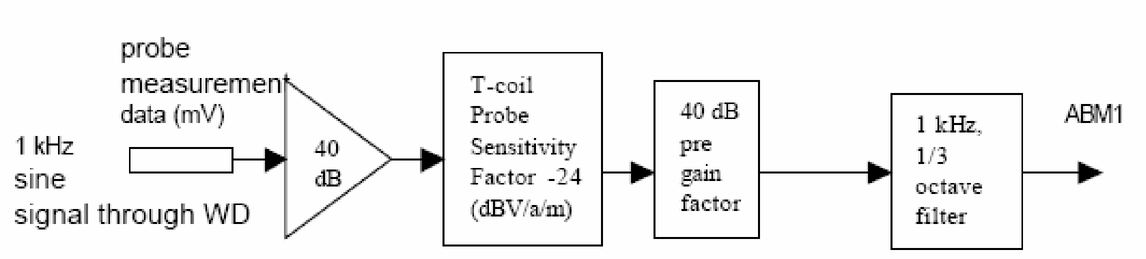
Table 6: Setup and configuration for system validation using TMFS

	Measured value dB (A/m)	**Manufacturer target value dB (A/m)**	**Delta (dB)**
Axial maximum signal	-20.40	-20.33	-0.07
Radial L maximum signal	-25.10	-26.01	+0.91
Radial T maximum signal	-26.30	-26.00	-0.30
Frequency Response	Flat	Flat	N/A

Table 7: Maximum measured, target field and delta values for system validation using TMFS

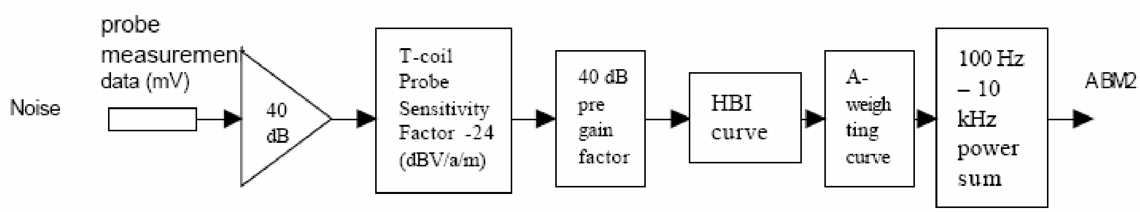
6.3 ABM1 / ABM2 detailed math and probe factor

ABM1 measurement flow chart:



Sine tone:
RTA 1 kHz (data + probe sensitivity of (24.0 dB V/(a/m)) – 40 dB pre-gain) = ABM1 (in dB (A/m))

ABM2 measurement flow chart:



Broadband noise:

Power Sum 1/3 octave, 0.1 - 10 kHz [RTA 0.1 – 10 kHz (data + probe sensitivity of (24.0 dB V/(A/m)) – 40 dB pre-gain)] + HBI curve + A_weighting curve = ABM2 (in dB (A/m))

ABM2 includes HBI as well as A-weighting curves as shown above.

The numerical values (ABM Noise) are the final result of the weighted integral. DASY4 uses filters by applying convolution in the time-domain. Therefore, significant contributions beyond 10 kHz would appear in the ABM2 result, even if they are not directly visible in the visualized spectrum.

6.4 Test measurement

1. Calibrate the AM1D probe using a Helmholtz coil with reference calibration signal as per section 6.1.
2. For each probe orientation, measure ambient noise.
3. A reference check of the test setup and instrumentation may be performed using a TMFS. Position the TMFS into the test setup at the position to be occupied by the WD. Measure the emissions from the TMFS and confirm that they are within tolerance of the expected values.
4. Position the WD in the test setup as shown on Figure 2 and connect the WD RF connector to a base station simulator.
5. Set the reference drive level for the system with the maximum volume control setting. The drive level is set such that the reference input level is input to the base station in the 1 kHz, 1/3 octave band. This drive level shall be used for the audio band signal test (ABM1 at fi). Either a sine wave at 1025 Hz or a voice-like signal shall be used for the reference audio signal. If interference is found at 1025 Hz an alternate reference audio signal frequency may be used. The same drive level will be used for the ABM1 frequency response measurements at each 1/3 octave band center frequency.
6. Determine the peak audio magnetic measurement for the WD device by scanning a 5x5 cm coarse (5 mm step) and a fine scan of 1.6x1.6 cm (axial), 2.4x1.6 cm (radial L), 1.6x2.4 cm (radial T) (2 mm step) and a point scan at maximum location for each probe orientation.
7. At each peak field measurement location measure and record the desired audio band magnetic signals (ABM1 at fi). The desired audio band input frequency (fi) shall be centered in each 1/3 octave band maintaining the same drive level and the reading taken for that band.
8. The separation distance of 1 cm is controlled between the center of the probe sensor and the top highest surface of the WD, throughout the measurement.

The following reference input levels that correlate to a normal speech input level shall be used for the standard transmission protocols.

STANDARD	TECHNOLOGY	INPUT (dBm0)
TIA/EIA/IS-2000	CDMA	-18
TIA/EIA/IS-136	TDMA (50 Hz)	-18
J-STD-007	GSM (217 Hz)	-16
IDEN	TDMA (22 and 11 Hz)	-18
T1/T1P1/3GPP	UMTS (WCDMA)	-16

Table 8: Normal speech input levels

8. At each peak field measurement location measure and record the undesired broadband audio magnetic signal (ABM2) with no signal applied (or digital zero applied, if appropriate) using A-weighting, and calculate the ratio of the desired to undesired signal strength (i.e. – signal quality)
9. From the measured signal to noise ratio, classify signal quality as T1 to T4 using the limits from Table 9.

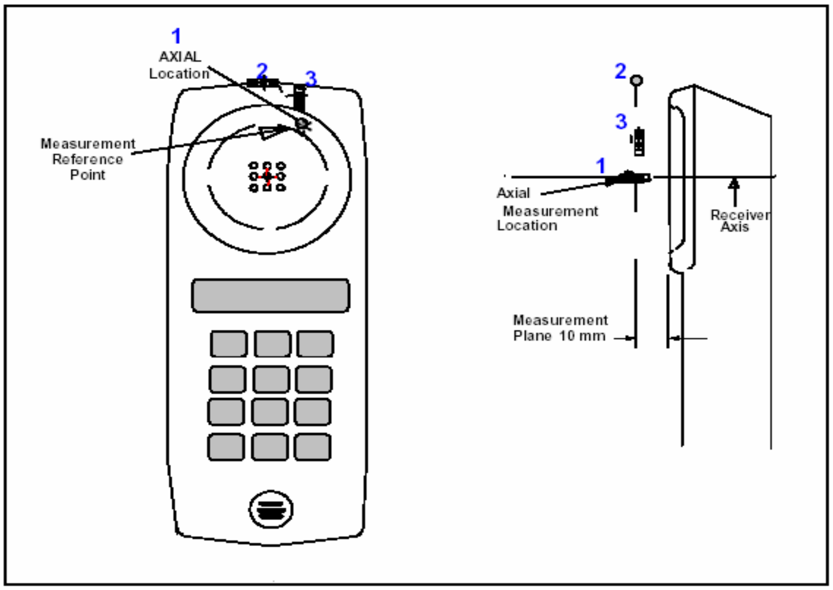


Figure 6: Axis & planes for WD audio band magnetic field measurements

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

Table 9: T-Coil signal quality categories

Field orientation	At frequency (KHz)	Audio Filter	Limit dB (A/m)
Axial, Radial L, Radial T	1.025	1/3 octave band	≥ -18

Table 10: Field Intensity (ABM1 signal) Limit

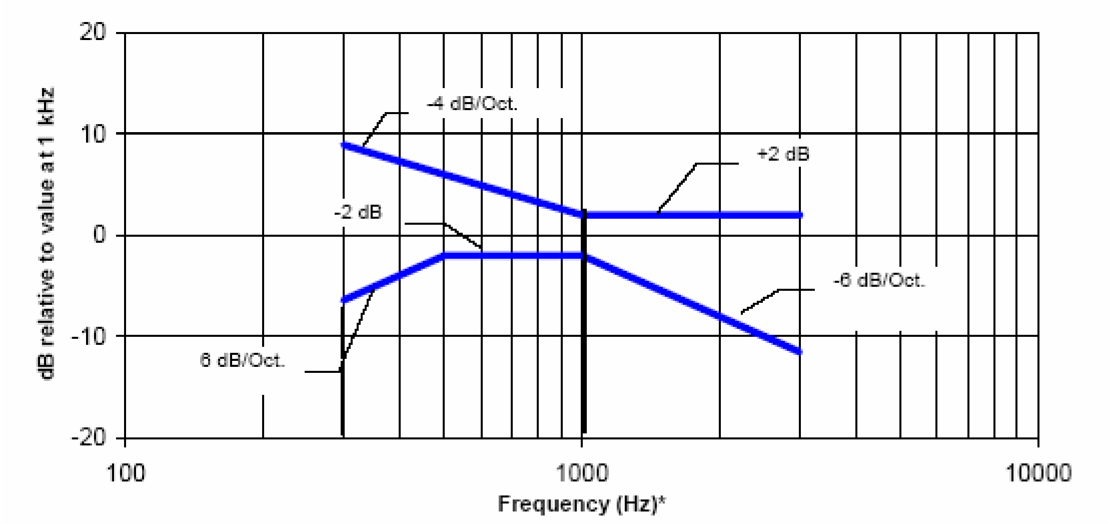


Figure 7: Magnetic field frequency response for WDs with a field between 10 dB and –13 dB (A/m) at 1 kHz

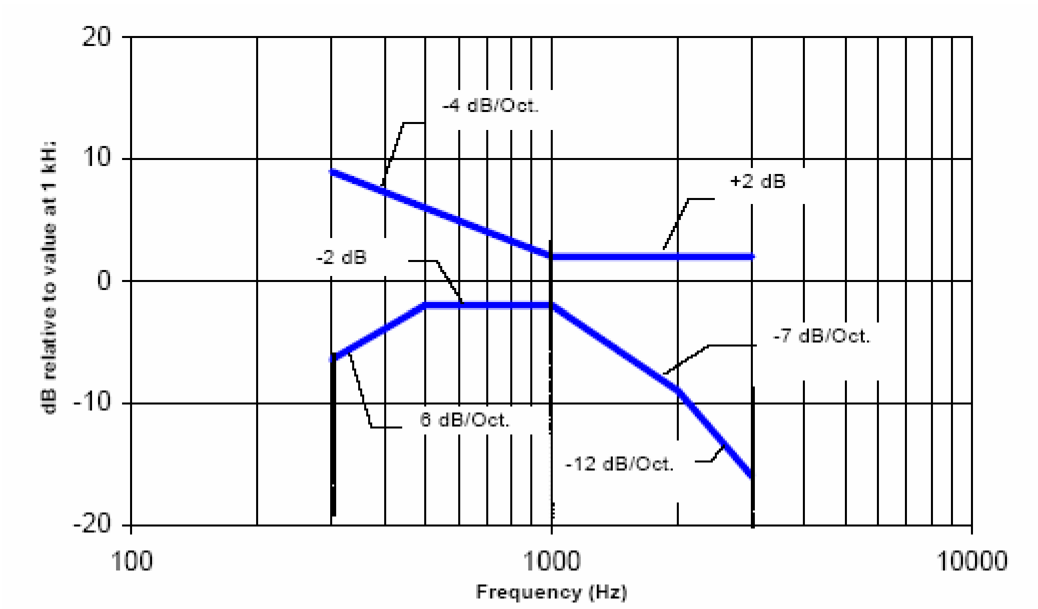


Figure 8: Magnetic field frequency response for WDs with a field that exceeds –10 dB(A/m) at 1 kHz

7.0 Summary of test results

Wireless Device: BlackBerry Smartphone – Model: RBY41GW										
Audio Band Magnetic Field Test										
Mode	**Probe orient.**	**Signal type**	**ABM1 dB (A/m)**	**ABM2 dB (A/m)**	**ABM1/ ABM2 dB**	**Freq. Resp. Verd.**	**T-Rating**	**RF Chan**	**Vocod. type**	**Noise Floor ABM2 dB (A/m)**
GSM 850	Axial	1.025 KHz sine	2.56	-49.8	52.4		T4	Low	FR V1	
	Axial	“	2.43	-48.8	51.2		T4	Low	FR V2	
	Axial	“	2.96	-49.4	52.3		T4	Low	HR V1	
	Axial	“	2.54	-49.1	51.7		T4	Low	FR AMR	
	Axial	“	2.15	-51.6	53.7		T4	Low	HR AMR	
	Axial	“	2.52	-50.0	52.5		T4	Low	FR V2	-58.8
	Radial L	“	-4.39	-53.4	49.1		T4	Low	FR V2	-59.3
	Radial T	“	-6.72	-56.2	49.5		T4	Low	FR V2	-59.4
	Axial	voice				Pass		Low	FR V2	
	Axial	1.025 KHz sine	2.57	-49.4	52.0		T4	Mid.	FR V2	
	Radial L	“	-4.42	-53.8	49.4		T4	Mid.	FR V2	
	Radial T	“	-6.73	-55.9	49.1		T4	Mid.	FR V2	
	Axial	“	2.54	-50.1	52.6		T4	High	FR V2	
	Radial L	“	-4.41	-53.9	49.5		T4	High	FR V2	
	Radial T	“	-6.74	-56.0	49.3		T4	High	FR V2	
GSM 1900	Axial	1.025 KHz sine	2.58	-49.3	51.9		T4	Low	FR V2	-58.8
	Radial L	“	-4.59	-54.4	49.8		T4	Low	FR V2	-59.3
	Radial T	“	-6.81	-55.9	49.1		T4	Low	FR V2	-59.4
	Axial	voice				Pass		Low	FR V2	
	Axial	1.025 KHz sine	2.50	-49.8	52.3		T4	Mid.	FR V2	
	Radial L	“	-4.36	-54.3	49.9		T4	Mid.	FR V2	
	Radial T	“	-6.82	-56.4	49.6		T4	Mid.	FR V2	
	Axial	“	2.49	-49.1	51.9		T4	High	FR V2	
	Radial L	“	-4.38	-53.5	49.2		T4	High	FR V2	
	Radial T	“	-6.84	-55.6	48.8		T4	High	FR V2	
Overall T-Rating							**T4**			
M-rating							**M3 ***			
Overall M/T rating							**M3T4**			

Table 11: ABM test data summary

***** M rating is taken from the HAC RF emission report number RTS-1114-0806-10. The worst case E or H-Field M rating centered at the axial T-coil location determines the RF rating. The worst case M rating centered at the axial speaker/T-Coil location is the same, M3.

7.1 Conclusion

The BlackBerry® Smartphone Model: RBY41GW is categorized to be M3T4 based on RF Emission and Audio Band Magnetic (ABM) T-Coil performance in accordance with ANSI C63.19-2007: American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids.

Therefore, the handheld is found to be in compliance with the requirements of FCC 20.19 (10-1-07 Edition) Hearing Aid-Compatible Mobile Handsets as modified by FCC Public Notice DA 06-1215 (Released: June 6, 2006) and FCC Report and Order (Feb. 28, 2008).

8.0 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
TEST 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 Std. uncertainty (ABM field)						4.1	6.2
Expanded Std. uncertainty [%]						**8.2**	**12.3**

Table 12: Worst-Case uncertainty budget for HAC T-Coil assessment according to ANSI C63.19.

8.1 Site-Specific Uncertainty

RF Reflections

ANSI C63.19 requires that any RF reflecting objects are a minimum distance of 2 wavelengths away from the WD under test. For this WD, the longest wavelength occurs when the WD is transmitting at 824.7MHz. The wavelength is:

$$\lambda = \frac{c}{f} = \frac{3 \cdot 10^8 \, m/s}{824.7 MHz} = 0.364m$$

Therefore, 2 wavelengths result in a distance of 0.73m. Tests are performed in an RF shielded chamber. The distance to the nearest wall is >1m and the distance to the robot's safety guardrail is > 1.0m, both satisfying the requirement. In addition, RF absorbing cones are placed at the base of the robot to further reduce reflections. The HAC phantom arch is made of low dielectric constant plastic and should not be a source of reflections.

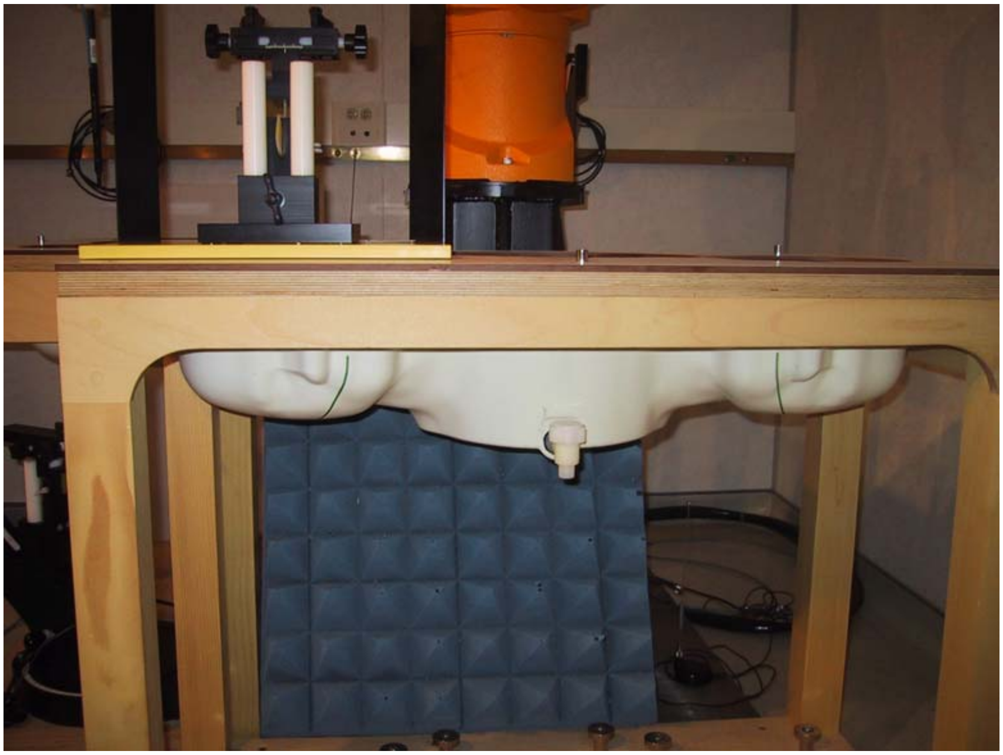


Figure 9: DASY4 system with absorbing material

Environmental Conditions

During measurements, the temperature of the test lab was kept between 21°C and 25°C and relative humidity was maintained between 20% and 55%.

Ambient Noise

ANSI C63.19 section 6 requires the ambient noise to be at least 10 dB below the measurement level, where applicable. Measurement of the ambient magnetic field was performed for each probe orientation and the levels are shown in the Table 8 and Annex B plots to be lower than ABM1 and ABM2 by at least 10 dB.