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 wireless portable device has been shown to be in compliance with FCC 20.19 (10-1-05 Edition), Hearing Aid-Compatible Mobile Handsets and FCC Public Notice DA 06-1215 (June 6, 2006).

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1.0 Introduction

This test report documents the 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.

The background noise evaluations were made for each probe orientation without an active WD in the area of the WD scan. The background noise were measured be lower by 10 dB than the measurements.

2.0 Applicable references

[1] ANSI C63.19-2006, American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids.

[2] FCC 47CFR § 20.19 (10-1-05 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.

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	RBN41GW		
FCC ID	L6ARBN40GW		
PIN Number	205F58A2 (RBN41GW)		
Prototype or Production Unit	Production		
Mode(s) of Operation	* GSM 850	GSM 1900	** Bluetooth
Nominal Maximum conducted RF Output Power	33.0 dBm	30.5 dBm	- 0.5 dBm
Tolerance in Power Setting on centre channel	± 0.50 dB	± 0.50 dB	N/A
Duty Cycle	1:8	1:8	N/A
Transmitting Frequency Range (MHz)	824.2 – 848.8	1850.2 – 1909.8	2402-2483

Table 1. Test device characterization

* GSM/EDGE 2-slots bands were not evaluated for HAC since peak RF power is lower by 2 dB in these modes.

** The BT operation for the device is with a BT headset. Therefore, BT operation does not affect HAC measurements since this mode of operation is not applicable to a HA user or HAC testing.

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	473	01/18/2008
SCHMID & Partner Engineering AG	Audio Band Magnetic Probe	AM1DV2	1016	04/19/2008
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	11/29/2007

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)	10	10
Averaging over signal repetitions	1	5

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 in section 6.2.

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 8.

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

.

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

5.10 Cabling

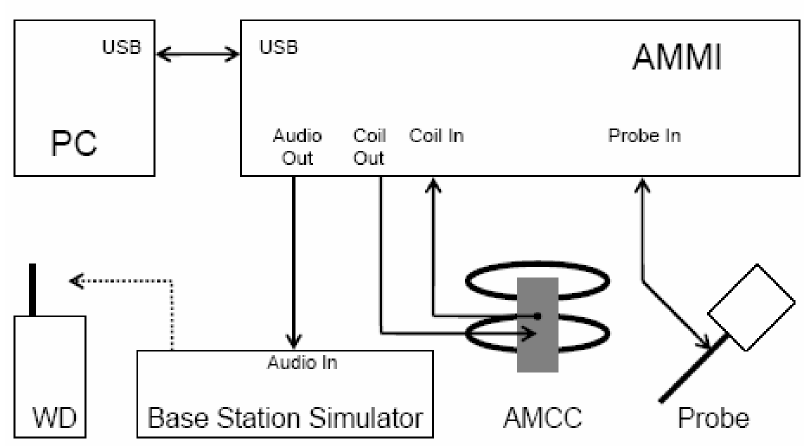


Figure 4: T-Coil set up cabling

6.0 Measurement procedures

6.1 Surface Check Job

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. The single values are interconnected with a blue line for the probe and a green line for the coil channel.

The probe sensitivity in measured to be 0.0646 V / (A/m) = ~ -24 dBV / (A/m) at 1 kHz as shown below:

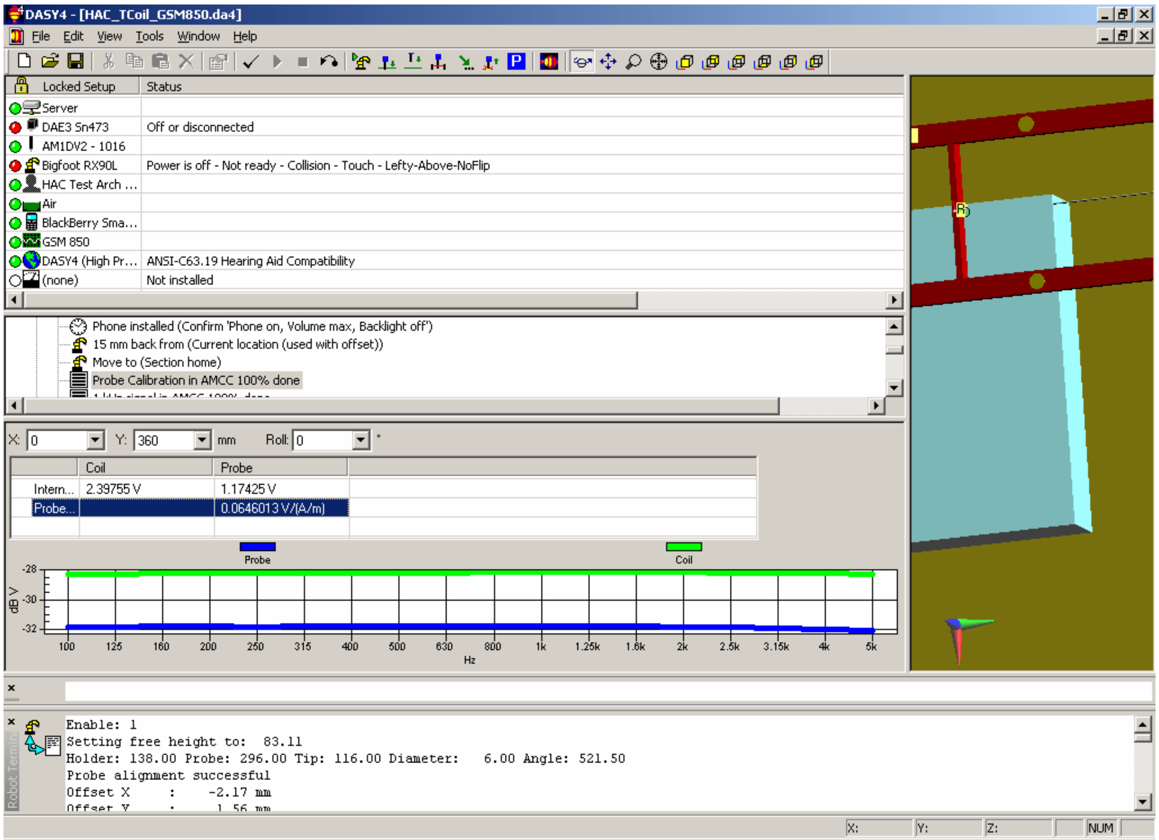


Figure 5. DASY4 ABM probe calibration

6.2 Input level measurement

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)

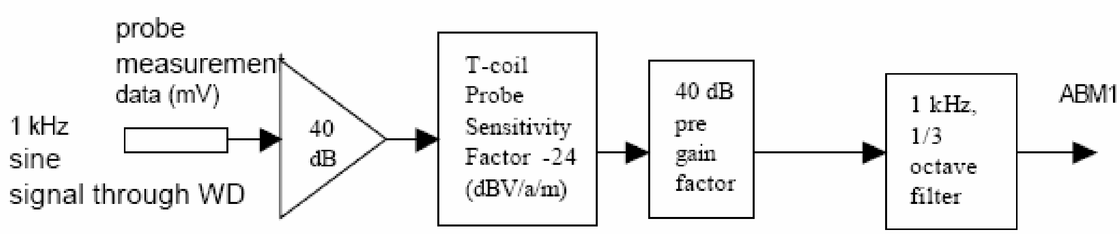
Where:
Z = signal required into CMU (dBV)
Y = desired dBm0 level (-16 dBm0 for GSM HAC T-coil testing)
X = full-scale calibration value (dBV)

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.

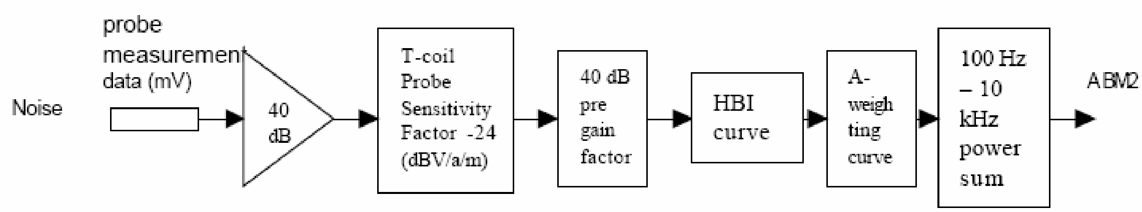
6.3 ABM1 / ABM2 detailed math and probe factor

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. Position the WD in the test setup as shown on Figure 2 and connect the WD RF connector to a base station simulator.
4. 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.
5. 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.
6. 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.
7. 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 5: 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 6.

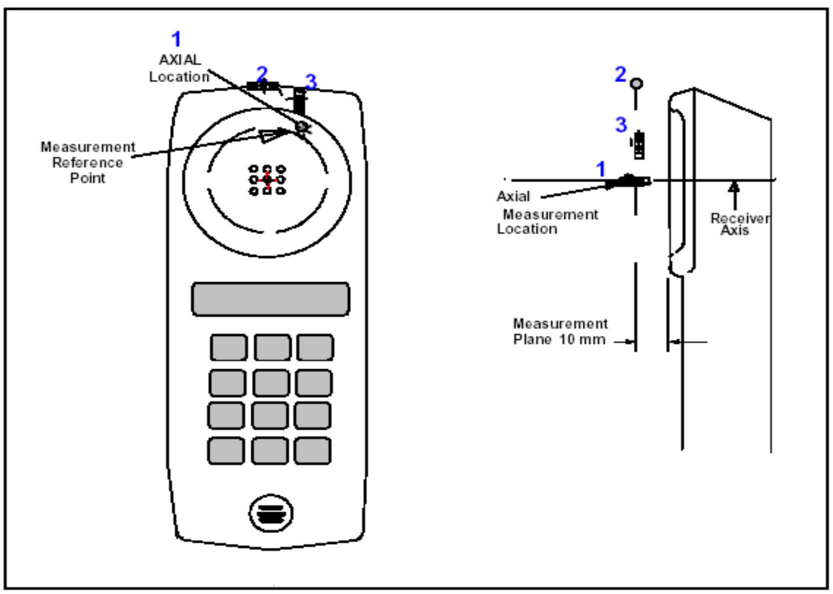


Figure 6: Axis & planes for WD audio band magnetic field measurements

Category	Telephone parameters WD signal quality ((signal + noise)-to-noise ratio in dB)	
	AWF = 0	AWF = -5
Category T1	-20 to -10 dB	-15 to -5 dB
Category T2	-10 to 0 dB	-5 to 5 dB
Category T3	0 to 10 dB	5 to 15 dB
Category T4	> 10 dB	>15 dB

Table 6: T-Coil signal quality categories

Field orientation	At frequency (KHz)	Audio filter	Limit dB (A/m)
Axial	1	1/3 octave band	≥ –13
Radial	1	1/3 octave band	≥ – 18

Table 7: Field Intensity (ABM1 signal) Limit

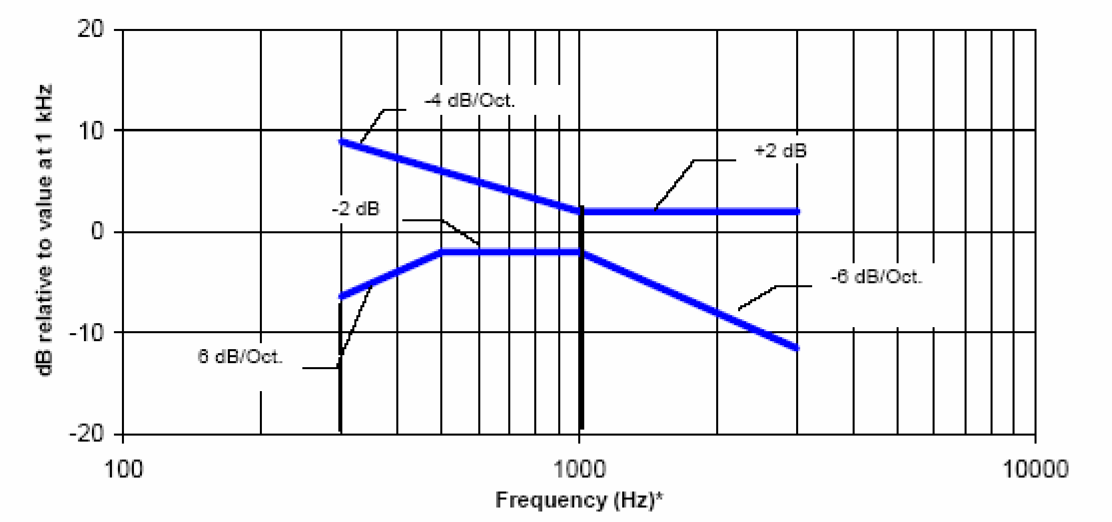


Figure 7: Magnetic field frequency response for WDs with a field between 10 dB and –13 dB (A/m) at 1 kHz

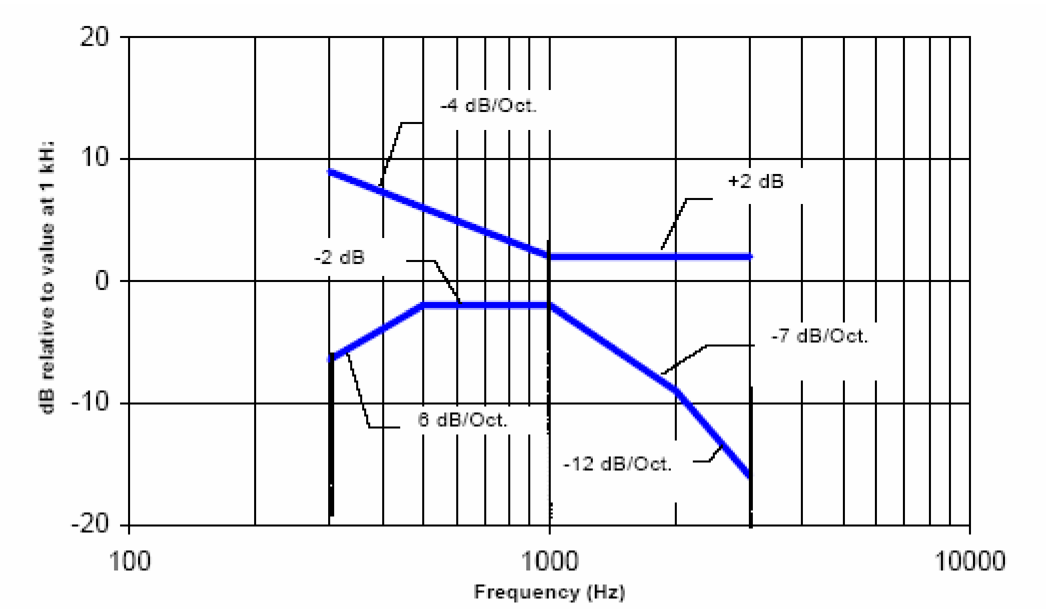


Figure 8: Magnetic field frequency response for WDs with a field that exceeds –10 dB(A/m) at 1 kHz

7.0 Summary of test results

Wireless Device: BlackBerry smartphone – Model: RBN41GW											
Audio Band Magnetic Field Test											
Mode	**Probe orient.**	**Sig. type**	**Cond. Pwr. (dBm)**	**ABM1 dB (A/m)**	**ABM2 dB (A/m)**	**ABM1 /ABM 2 dB**	**Freq. Resp. Verd.**	**T-Rating**	**RF Chan**	**Vocod. type**	**Noise Floor ABM2 dB (A/m)**
GSM 850	Axial	1.025 KHz sine	33.2	-9.08	-28.20	19.12		T4	Low	FR V2	
	Axial	sine	33.2	-8.84	-28.25	19.41		T4	Low	FR V1	
	Axial	sine	33.2	-8.41	-30.83	22.42		T4	Low	HR V1	
	Axial	sine	33.2	-8.94	-28.35	19.42		T4	Low	FR AMR	
	Axial	sine	33.2	-9.45	-30.73	21.28		T4	Low	HR AMR	
	Axial	sine	33.2	-8.79	-28.06	19.27		T4	Low	FR V2	-59.37
	Radial L	sine	33.2	-17.22	-24.56	7.34		T3	Low	FR V2	-58.78
	Radial T	sine	33.2	-17.66	-30.45	12.80		T3	Low	FR V2	-59.39
	Axial	voice	33.2				Pass		Low	FR V2	
	Axial	sine	32.9	-8.26	-28.53	20.27		T4	Mid.	FR V2	
	Radial L	sine	32.9	-17.23	-24.85	7.63		T3	Mid.	FR V2	
	Radial T	sine	32.9	-17.64	-30.35	12.71		T3	Mid.	FR V2	
	Axial	sine	32.8	-8.73	-27.88	19.15		T4	High	FR V2	
	Radial L	sine	32.8	-17.15	-24.4	7.25		T3	High	FR V2	
	Radial T	sine	32.8	-17.62	-30.44	12.82		T3	High	FR V2	
GSM 1900	Axial	sine	30.8	-10.34	-31.31	20.97		T4	Low	FR V2	-59.36
	Radial L	sine	30.8	-17.78	-28.66	10.88		T3	Low	FR V2	-58.80
	Radial T	sine	30.8	-17.49	-31.06	13.56		T3	Low	FR V2	-59.42
	Axial	voice	30.8				Pass		Low	FR V2	
	Axial	sine	30.8	-10.32	-32.11	21.78		T4	Mid.	FR V2	
	Radial L	sine	30.6	-17.42	-28.53	11.11		T3	Mid.	FR V2	
	Radial T	sine	30.6	-17.53	-31.24	13.71		T3	Mid.	FR V2	
	Axial	sine	30.6	-10.33	-31.84	21.51		T4	High	FR V2	
	Radial L	sine	30.6	-17.77	-29.32	11.55		T3	High	FR V2	
	Radial T	sine	30.6	-17.51	-31.16	13.65		T3	High	FR V2	
Overall T-Rating								**T3**			
M-rating								**M3 ***			
Overall M/T rating								**M3T3**			

Table 8: ABM test data summary

***** M rating is taken from the HAC RF emission report number RTS-0671-0706-11. The worst case E or H-Field M rating centered at the axial T-coil location determines the RF rating. In this case the worst case M rating centered at the axial T_coil location is M3.

7.1 Conclusion

The BlackBerry® smartphone Model Number RBN41GW is categorized to be M3T3 based on RF emission and Audio Band Magnetic (ABM) T-Coil performance in accordance with ANSI C63.19-2006: American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids.

Therefore, the device is found to be in compliance with the requirements of FCC 20.19 (10-1-05 Edition) Hearing Aid-Compatible Mobile Handsets as modified by FCC Public Notice DA 06-1215 (Released: June 6, 2006).

8.0 Measurement uncertainty

Table 9 outlines the measurement uncertainty for the SPEAG DASY4 measurement system.

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 9: 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.

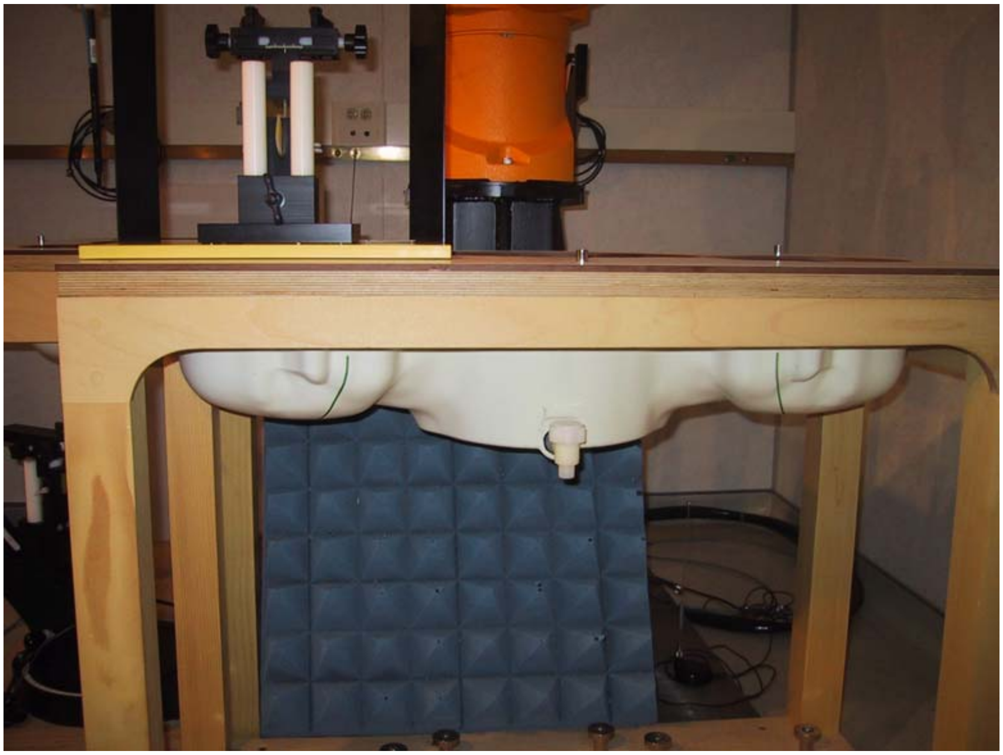


Figure 9: DASY4 system with absorbing material

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. 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.

Annex A: Probe calibration and reference signal measurement plots

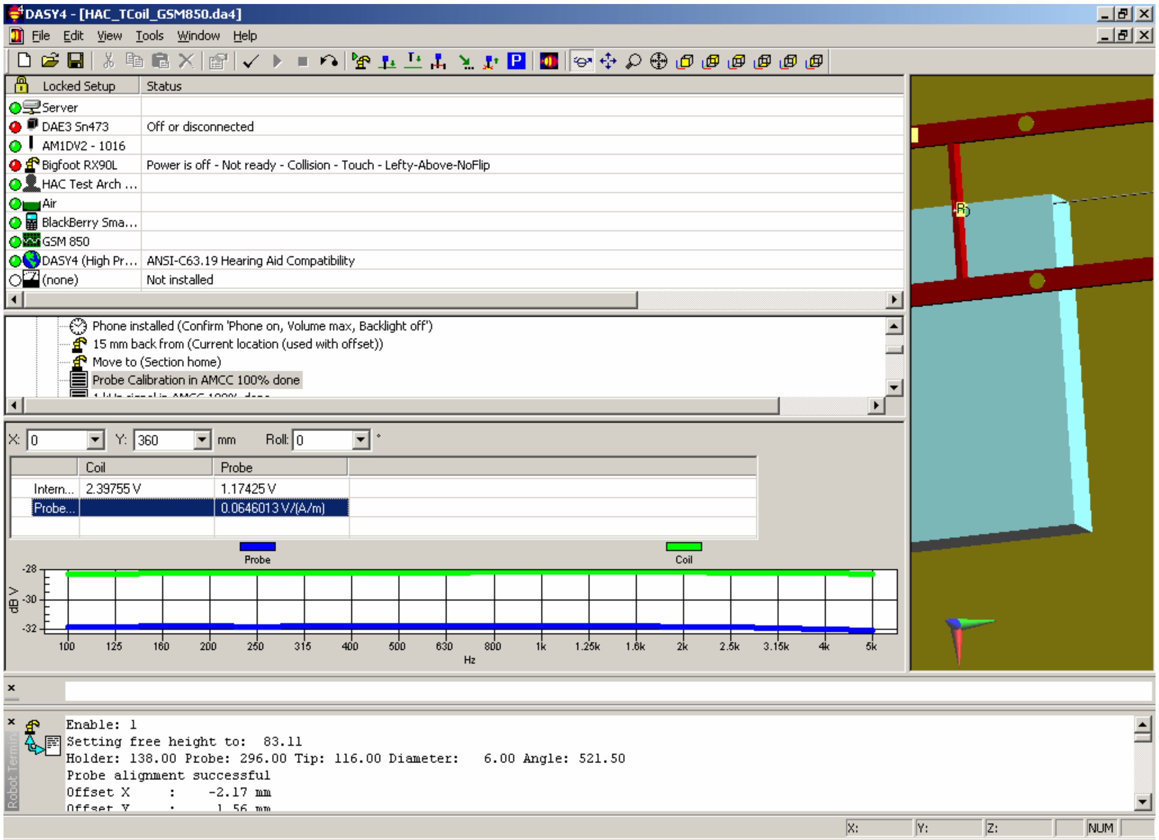


Figure A1: Probe calibration data for coil and probe

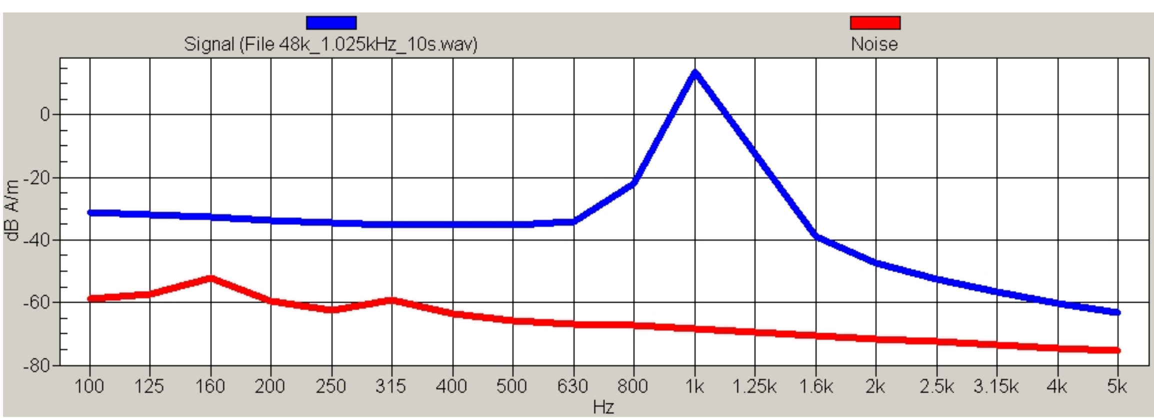


Figure A2: Reference sinusoidal 1.025 KHz signal and noise

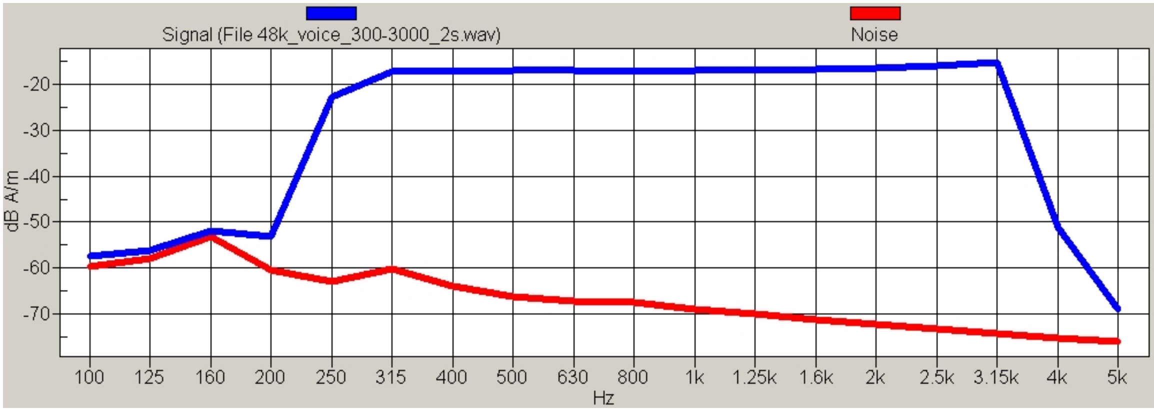


Figure A3: Reference voice simulated signal and noise

Annex B: Ambient noise floor data and plots

Date/Time: 14/06/2007 11:36:22 AM

Test Laboratory: RTS

HAC_TCoil_GSM850_axial

DUT: N/A; Type: Sample ; Serial: Not Specified

Communication System: GSM 850; Frequency: 836.8 MHzFrequency: 824.2 MHzFrequency: 848.8 MHz;Duty Cycle: 1:8.3
Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:

- Probe: AM1DV2 - 1016; ; Calibrated: 19/04/2007
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn473; Calibrated: 18/01/2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Background noise 5mm above Grid Reference/z (axial) noise/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -59.3694 dB A/m
Location: 0, 0, 368.7 mm

Background noise 5mm above Grid Reference/x (longitudinal) noise/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -58.7767 dB A/m
Location: 0, 0, 368.7 mm

Background noise 5mm above Grid Reference/y (transversal) noise/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -59.3941 dB A/m
Location: 0, 0, 368.7 mm

Date/Time: 15/06/2007 6:05:07 PM

Test Laboratory: RTS

HAC_TCoil_GSM1900_axial

DUT: N/A; Type: Sample ; Serial: Not Specified

Communication System: GSM 1900; Frequency: 1880 MHzFrequency: 1850.2 MHzFrequency: 1909.8 MHz;Duty Cycle: 1:8.3
Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3
Phantom section: AMB with Coil Section

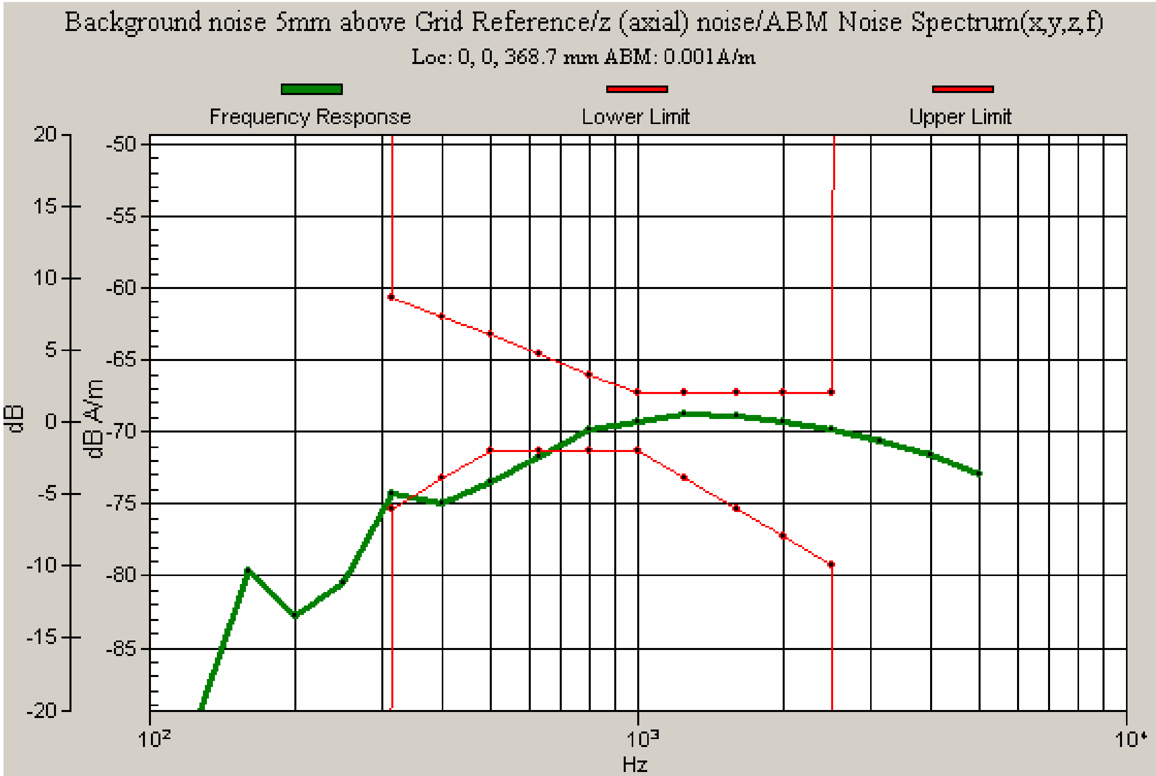
DASY4 Configuration:

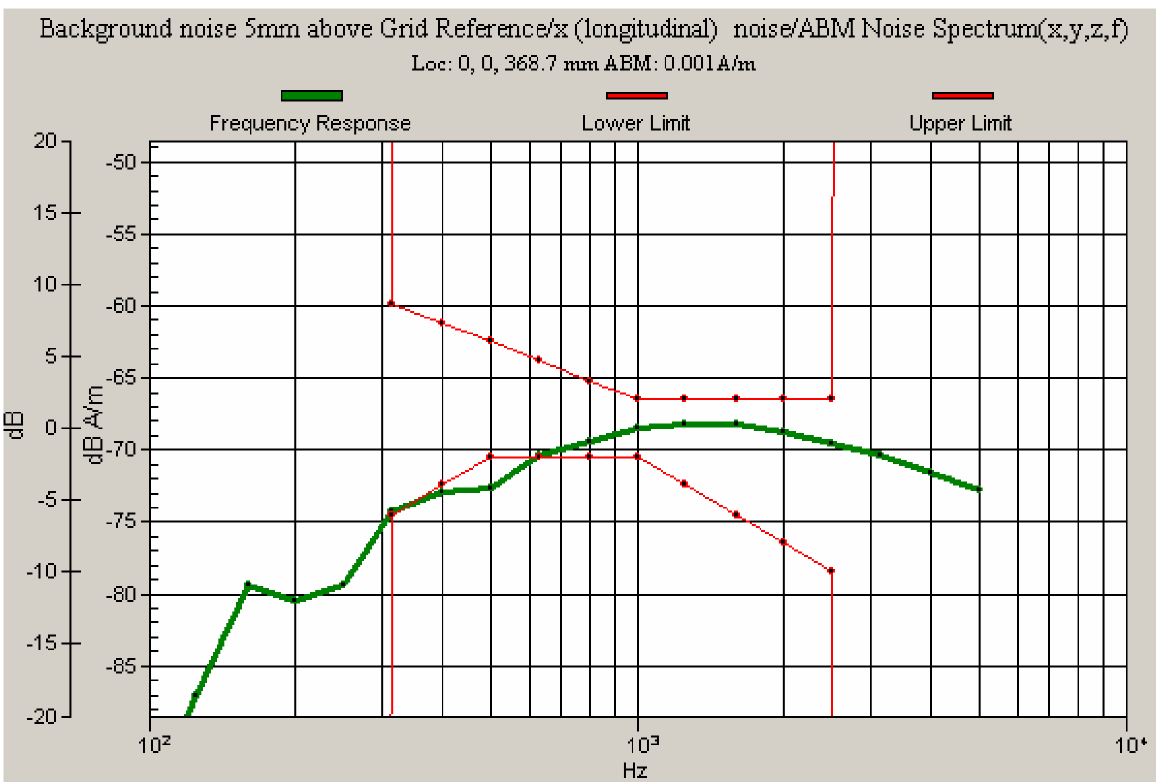
- Probe: AM1DV2 - 1016; ; Calibrated: 19/04/2007
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn473; Calibrated: 18/01/2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

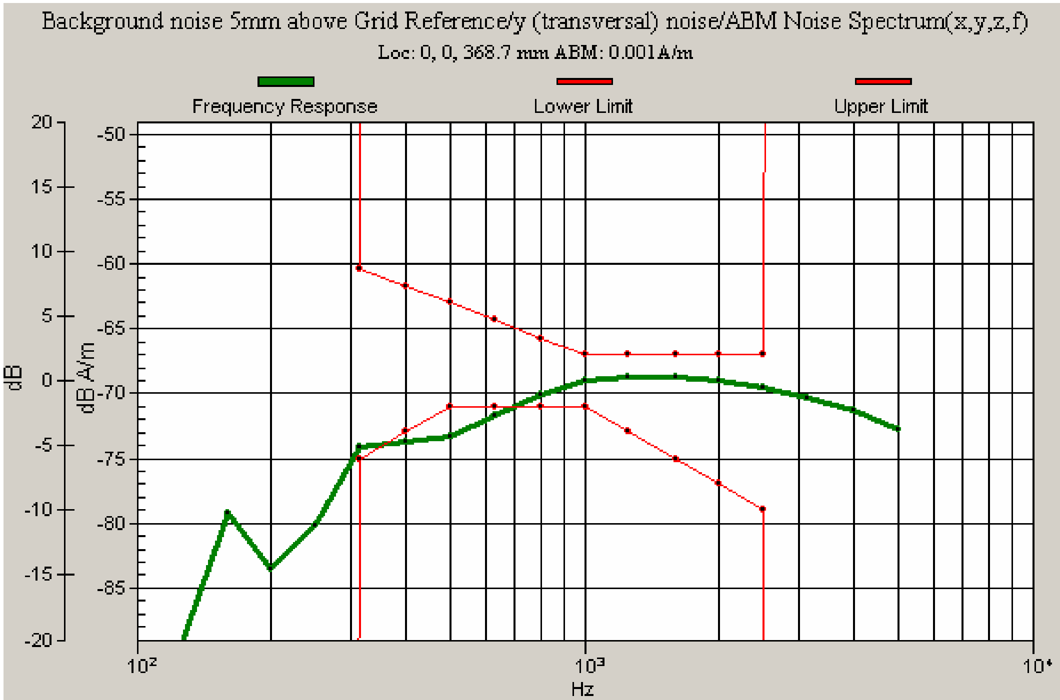
Background noise 5mm above Grid Reference/z (axial) noise/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -59.3556 dB A/m
Location: 0, 0, 368.7 mm

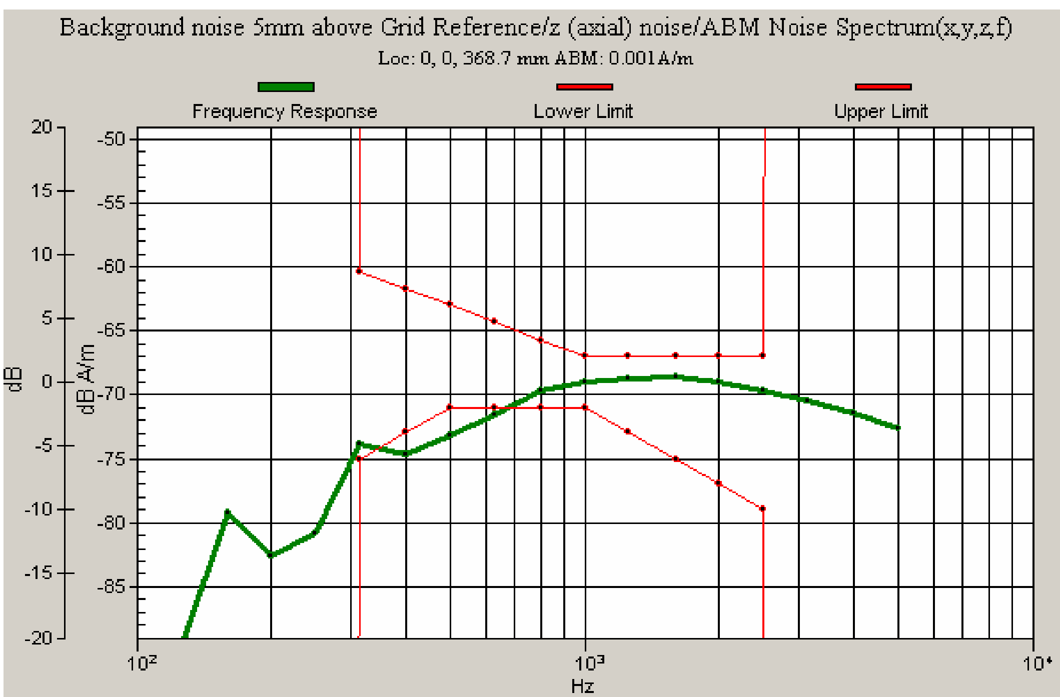
Background noise 5mm above Grid Reference/x (longitudinal) noise/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -58.8045 dB A/m
Location: 0, 0, 368.7 mm

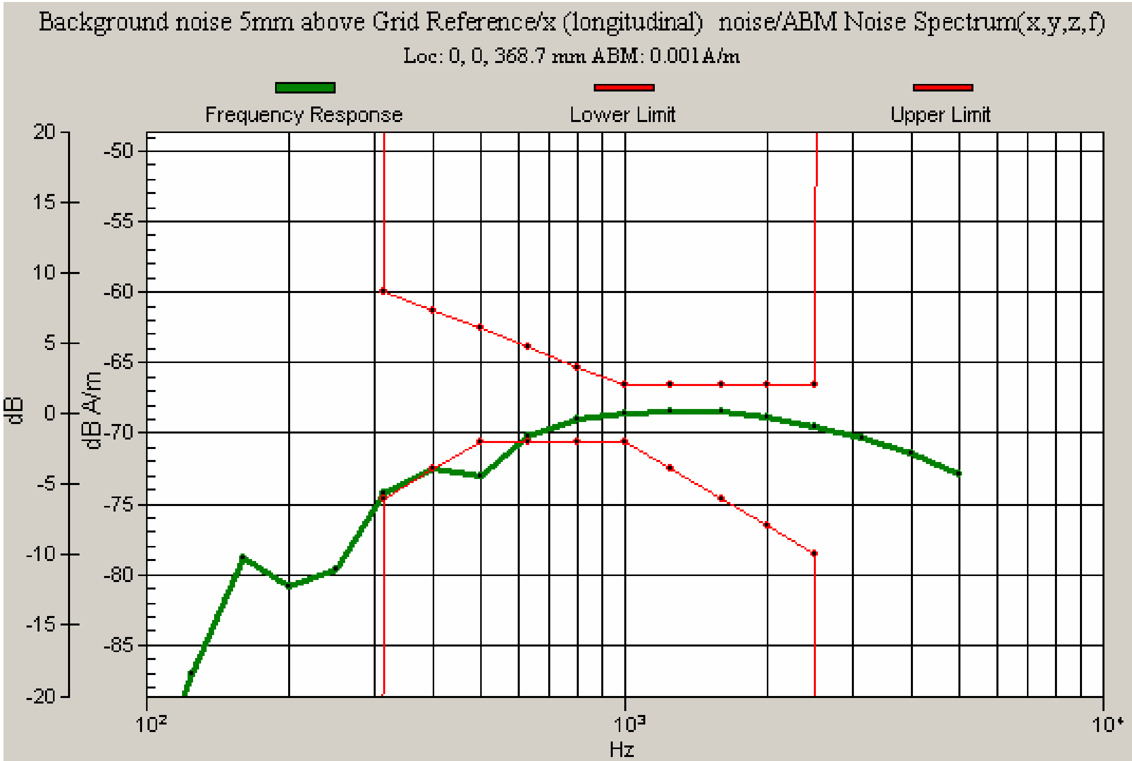
Background noise 5mm above Grid Reference/y (transversal) noise/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -59.4184 dB A/m
Location: 0, 0, 368.7 mm


Background noise 5mm above Grid Reference/z (axial) noise/ABM Noise Spectrum(x,y,z,f)
Loc: 0, 0, 368.7 mm ABM: 0.001A/m
Frequency Response
Lower Limit
Upper Limit
dB
dB A/m
Hz

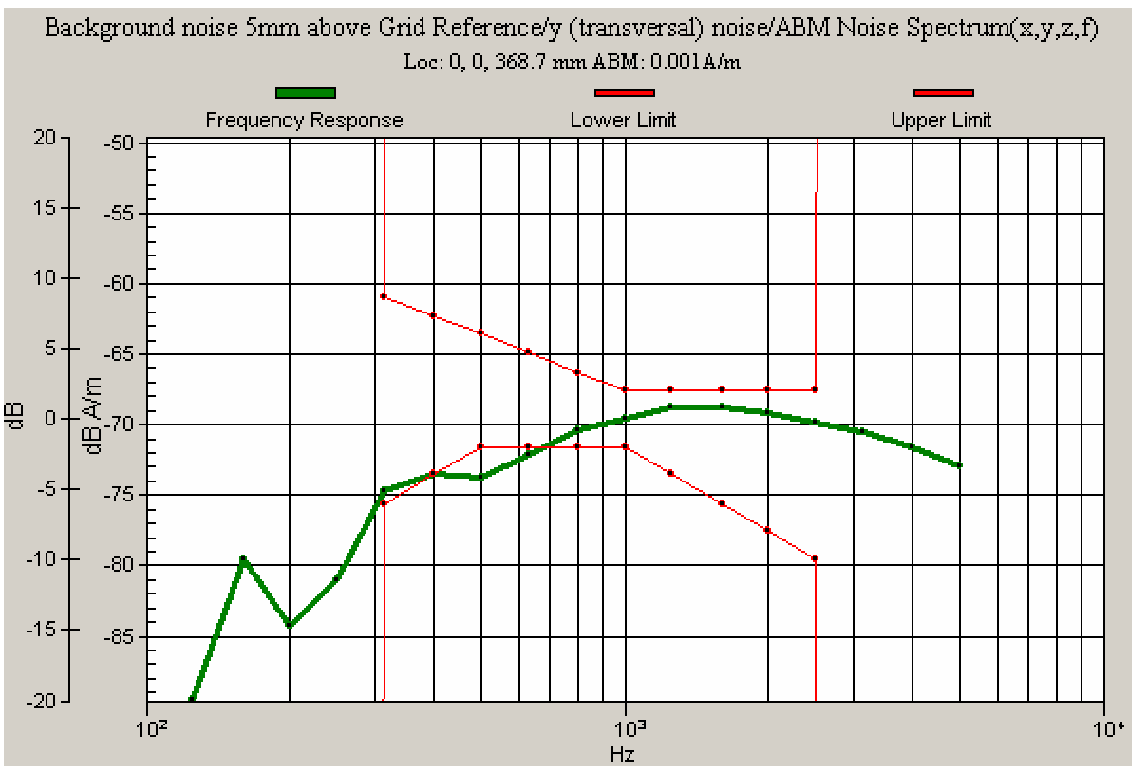

Background noise 5mm above Grid Reference/x (longitudinal) noise/ABM Noise Spectrum(x,y,z,f)
Loc: 0, 0, 368.7 mm ABM: 0.001A/m
Frequency Response
Lower Limit
Upper Limit
dB
dB A/m
Hz


Background noise 5mm above Grid Reference/y (transversal) noise/ABM Noise Spectrum(x,y,z,f)
Loc: 0, 0, 368.7 mm ABM: 0.001A/m
Frequency Response
Lower Limit
Upper Limit
dB
dB A/m
Hz
10²
10³
10⁴


Background noise 5mm above Grid Reference/z (axial) noise/ABM Noise Spectrum(x,y,z,f)
Loc: 0, 0, 368.7 mm ABM: 0.001A/m
Frequency Response
Lower Limit
Upper Limit
dB
dB A/m
Hz
10²
10³
10⁴



Background noise 5mm above Grid Reference/x (longitudinal) noise/ABM Noise Spectrum(x,y,z,f)
Loc: 0, 0, 368.7 mm ABM: 0.001A/m
Frequency Response
Lower Limit
Upper Limit
dB
dB A/m
Hz



Background noise 5mm above Grid Reference/y (transversal) noise/ABM Noise Spectrum(x,y,z,f)
Loc: 0, 0, 368.7 mm ABM: 0.001A/m
Frequency Response
Lower Limit
Upper Limit
dB
dB A/m
Hz

Annex C: Audio Band Magnetic measurement data and plots

Date/Time: 14/06/2007 11:36:22 AM

Test Laboratory: RTS

HAC_TCoil_GSM850_axial

DUT: BlackBerry Smartphone; Type: Sample ; Serial: Not Specified

Communication System: GSM 850; Frequency: 836.8 MHzFrequency: 824.2 MHzFrequency: 848.8 MHz;Duty Cycle: 1:8.3
Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:

- Probe: AM1DV2 - 1016; ; Calibrated: 19/04/2007
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn473; Calibrated: 18/01/2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Scans/z (axial) rough 50 x 50/ABM Signal(x,y,z) (11x11x1):
Measurement grid: dx=5mm, dy=5mm
Cursor:
ABM1 comp = -8.60438 dB A/m
BWC Factor = 0.007727 dB
Location: 0, 0, 363.7 mm

Scans/z (axial) 16 x 16/ABM Signal(x,y,z) (9x9x1):
Measurement grid: dx=2mm, dy=2mm
Cursor:
ABM1 comp = -8.24246 dB A/m
BWC Factor = 0.007727 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max z/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.26274 dB A/m
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max z/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -28.5291 dB A/m
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max z/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 20.2664 dB
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max V1 FR_/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.83939 dB A/m
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max V1 FR_/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -28.2533 dB A/m
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max V1 FR_/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 19.4139 dB
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max V2 FR/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -9.08136 dB A/m
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max V2 FR/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -28.2018 dB A/m
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max V2 FR/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 19.1204 dB
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max V1 HR/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.40751 dB A/m
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max V1 HR/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -30.8255 dB A/m
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max V1 HR/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 22.418 dB
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max AMR FR/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.93746 dB A/m
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max AMR FR/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -28.3549 dB A/m
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max AMR FR/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 19.4175 dB
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max AMR HR/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -9.4535 dB A/m
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max AMR HR/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm

Cursor:
ABM2 = -30.7339 dB A/m
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max AMR HR/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 21.2804 dB
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm

Point measurement 2/z (axial) at max z/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.78883 dB A/m
BWC Factor = 0.00729308 dB
Location: -2, -2, 363.7 mm

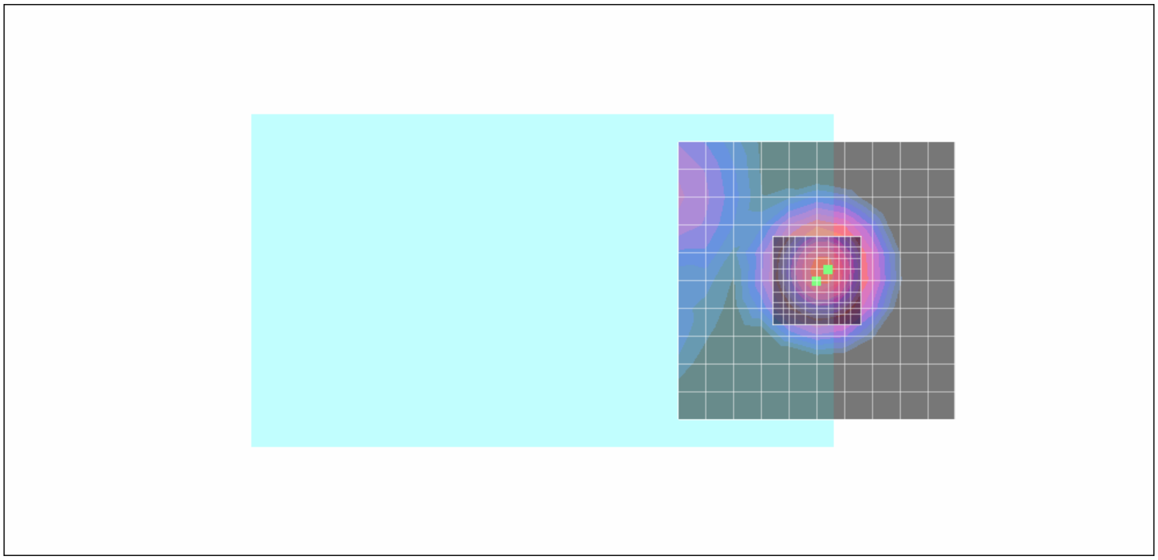
Point measurement 2/z (axial) at max z/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -28.0574 dB A/m
Location: -2, -2, 363.7 mm

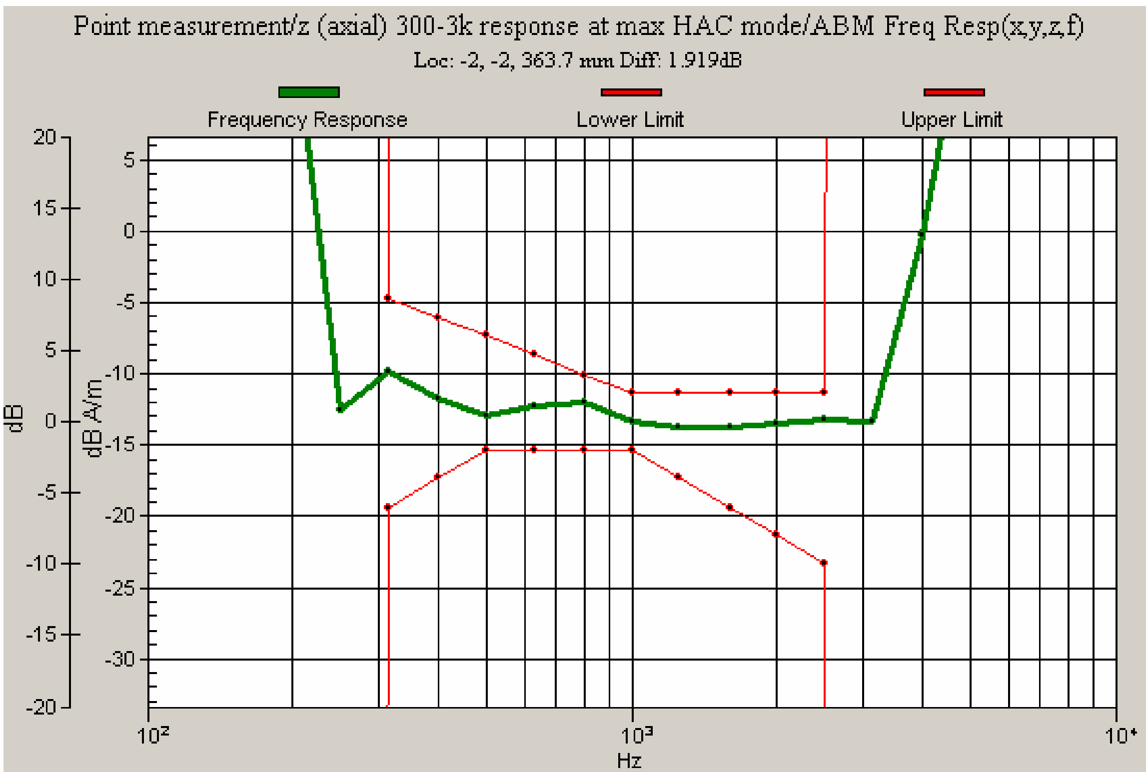
Point measurement 2/z (axial) at max z/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 19.2686 dB
BWC Factor = 0.00729308 dB
Location: -2, -2, 363.7 mm

Point measurement 3/z (axial) at max z/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -8.73169 dB A/m
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm

Point measurement 3/z (axial) at max z/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -27.8776 dB A/m
Location: -2, -2, 363.7 mm

Point measurement 3/z (axial) at max z/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 19.146 dB
BWC Factor = 0.00746665 dB
Location: -2, -2, 363.7 mm




Point measurement/z (axial) 300-3k response at max HAC mode/ABM Freq Resp(x,y,z,f)
Loc: -2, -2, 363.7 mm Diff: 1.919dB
Frequency Response
Lower Limit
Upper Limit
dB
dB A/m
Hz

Date/Time: 14/06/2007 11:54:22 AM

Test Laboratory: RTS

HAC_TCoil_GSM850_radial L

DUT: BlackBerry Smartphone; Type: Sample ; Serial: Not Specified

Communication System: GSM 850; Frequency: 836.8 MHzFrequency: 824.2 MHzFrequency: 848.8 MHz;Duty Cycle: 1:8.3
Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:

- Probe: AM1DV2 - 1016; ; Calibrated: 19/04/2007
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn473; Calibrated: 18/01/2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Scans/x (longitudinal) 24 x 16/ABM Signal(x,y,z) (13x9x1):
Measurement grid: dx=2mm, dy=2mm
Cursor:
ABM1 comp = -16.8188 dB A/m
BWC Factor = 0.007727 dB
Location: -8, -2, 363.7 mm

Point measurement/x (longitudinal) at max x 3/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -17.2236 dB A/m
BWC Factor = 0.00746665 dB
Location: -10, -2, 363.7 mm

Point measurement/x (longitudinal) at max x 3/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -24.8537 dB A/m
Location: -10, -2, 363.7 mm

Point measurement/x (longitudinal) at max x 3/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 7.6301 dB
BWC Factor = 0.00746665 dB
Location: -10, -2, 363.7 mm

Point measurement 2/x (longitudinal) at max x/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -17.2156 dB A/m
BWC Factor = 0.00729308 dB
Location: -10, -2, 363.7 mm

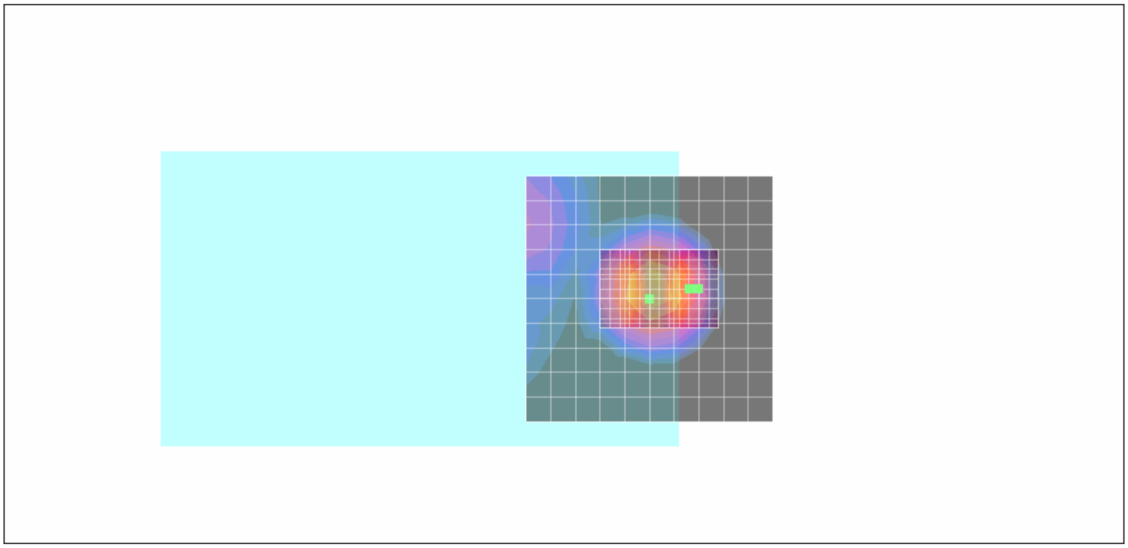
Point measurement 2/x (longitudinal) at max x/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -24.5614 dB A/m
Location: -10, -2, 363.7 mm

Point measurement 2/x (longitudinal) at max x/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 7.34575 dB
BWC Factor = 0.00729308 dB
Location: -10, -2, 363.7 mm

Point measurement 3/x (longitudinal) at max x/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -17.1493 dB A/m
BWC Factor = 0.00746665 dB
Location: -10, -2, 363.7 mm

Point measurement 3/x (longitudinal) at max x/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -24.4017 dB A/m
Location: -10, -2, 363.7 mm

Point measurement 3/x (longitudinal) at max x/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 7.25237 dB
BWC Factor = 0.00746665 dB
Location: -10, -2, 363.7 mm



0 dB = 1.00A/m

Date/Time: 14/06/2007 11:54:22 AM

Test Laboratory: RTS

HAC_TCoil_GSM850_radial T

DUT: BlackBerry Smartphone; Type: Sample ; Serial: Not Specified

Communication System: GSM 850; Frequency: 836.8 MHzFrequency: 824.2 MHzFrequency: 848.8 MHz;Duty Cycle: 1:8.3
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:

- Probe: AM1DV2 - 1016; ; Calibrated: 19/04/2007
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn473; Calibrated: 18/01/2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Scans/y (transversal) 16 x 24/ABM Signal(x,y,z) (9x13x1):
Measurement grid: dx=2mm, dy=2mm
Cursor:
ABM1 comp = -17.9613 dB A/m
BWC Factor = 0.007727 dB
Location: 0, -10, 362.7 mm

Point measurement/y (transversal) at max y/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -17.6425 dB A/m
BWC Factor = 0.00746665 dB
Location: 0, -10, 362.7 mm

Point measurement/y (transversal) at max y/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -30.3542 dB A/m
Location: 0, -10, 362.7 mm

Point measurement/y (transversal) at max y/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 12.7117 dB
BWC Factor = 0.00746665 dB
Location: 0, -10, 362.7 mm

Point measurement 2/y (transversal) at max y/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -17.6557 dB A/m
BWC Factor = 0.00729308 dB
Location: 0, -10, 362.7 mm

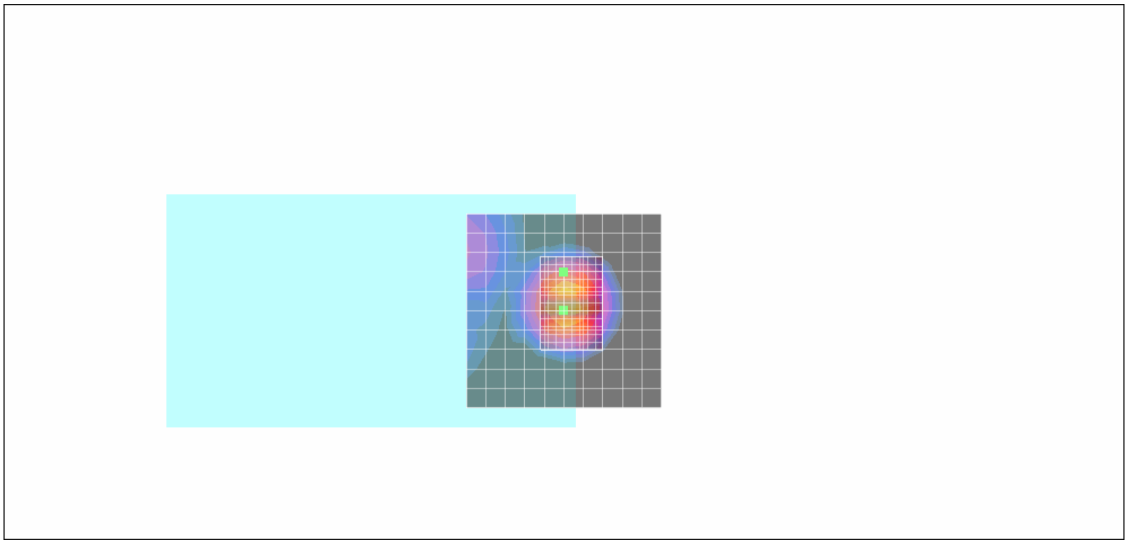
Point measurement 2/y (transversal) at max y/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -30.4536 dB A/m
Location: 0, -10, 362.7 mm

Point measurement 2/y (transversal) at max y/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 12.7978 dB
BWC Factor = 0.00729308 dB
Location: 0, -10, 362.7 mm

Point measurement 3/y (transversal) at max y/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -17.6165 dB A/m
BWC Factor = 0.00746665 dB
Location: 0, -10, 362.7 mm

Point measurement 3/y (transversal) at max y/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -30.4373 dB A/m
Location: 0, -10, 362.7 mm

Point measurement 3/y (transversal) at max y/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 12.8208 dB
BWC Factor = 0.00746665 dB
Location: 0, -10, 362.7 mm



0 dB = 1.00A/m

Date/Time: 15/06/2007 6:05:07 PM

Test Laboratory: RTS

HAC_TCoil_GSM1900_axial

DUT: BlackBerry Smartphone; Type: Sample ; Serial: Not Specified

Communication System: GSM 1900; Frequency: 1880 MHzFrequency: 1850.2 MHzFrequency: 1909.8 MHz;Duty Cycle: 1:8.3
Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:

- Probe: AM1DV2 - 1016; ; Calibrated: 19/04/2007
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn473; Calibrated: 18/01/2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Scans/z (axial) rough 50 x 50/ABM Signal(x,y,z) (11x11x1):
Measurement grid: dx=5mm, dy=5mm
Cursor:
ABM1 comp = -8.60438 dB A/m
BWC Factor = 0.007727 dB
Location: 0, 0, 363.7 mm

Scans/z (axial) 16 x 16/ABM Signal(x,y,z) (9x9x1):
Measurement grid: dx=2mm, dy=2mm
Cursor:
ABM1 comp = -10.2375 dB A/m
BWC Factor = 0.007727 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max z/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -10.3235 dB A/m
BWC Factor = 0.0072063 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max z/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -32.1094 dB A/m
Location: -2, -2, 363.7 mm

Point measurement/z (axial) at max z/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 21.7859 dB
BWC Factor = 0.0072063 dB
Location: -2, -2, 363.7 mm

Point measurement/z (axial) 300-3k response at max HAC mode/ABM Freq Resp(x,y,z,f) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
Diff = 1.54903 dB
BWC Factor = 10.8 dB
Location: -2, -2, 363.7 mm

Point measurement 2/z (axial) at max z/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -10.342 dB A/m
BWC Factor = 0.00737987 dB
Location: -2, -2, 363.7 mm

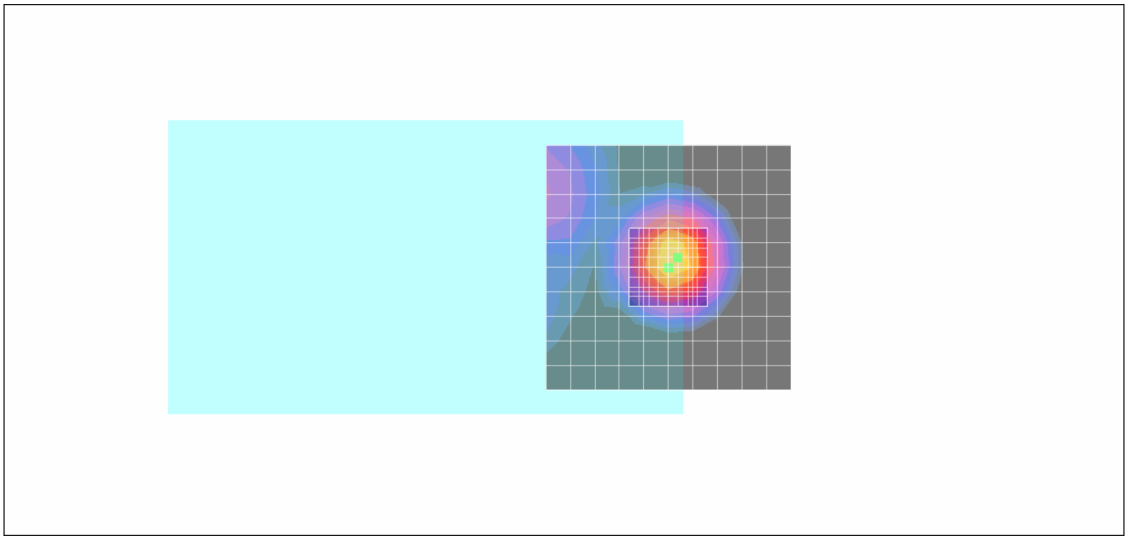
Point measurement 2/z (axial) at max z/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -31.3128 dB A/m
Location: -2, -2, 363.7 mm

Point measurement 2/z (axial) at max z/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 20.9707 dB
BWC Factor = 0.00737987 dB
Location: -2, -2, 363.7 mm

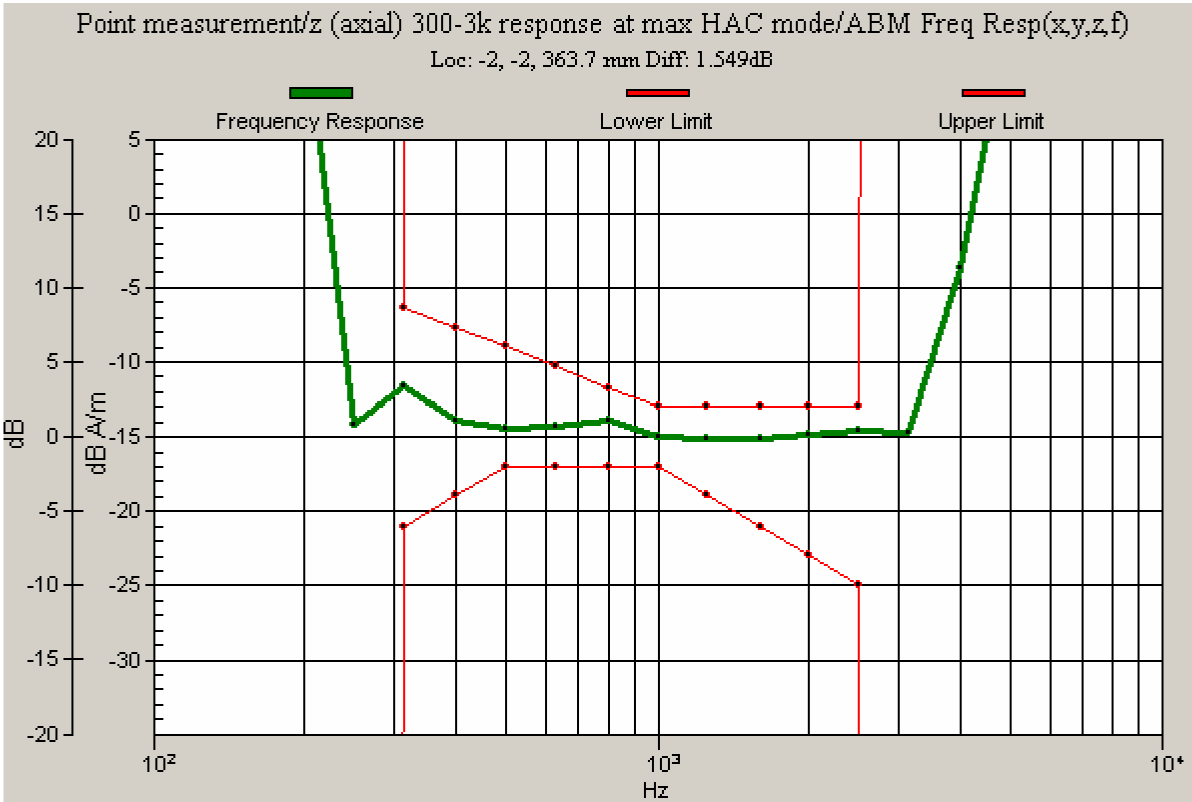
Point measurement 3/z (axial) at max z/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -10.3275 dB A/m
BWC Factor = 0.00711951 dB
Location: -2, -2, 363.7 mm

Point measurement 3/z (axial) at max z/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -31.836 dB A/m
Location: -2, -2, 363.7 mm

Point measurement 3/z (axial) at max z/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 21.5085 dB
BWC Factor = 0.00711951 dB
Location: -2, -2, 363.7 mm



0 dB = 1.00A/m


Point measurement/z (axial) 300-3k response at max HAC mode/ABM Freq Resp(x,y,z,f)
Loc: -2, -2, 363.7 mm Diff: 1.549dB
Frequency Response
Lower Limit
Upper Limit
dB
dB A/m
Hz

Date/Time: 14/06/2007 11:54:22 AM

Test Laboratory: RTS

HAC_TCoil_GSM1900_radial_L

DUT: BlackBerry Smartphone; Type: Sample ; Serial: Not Specified

Communication System: GSM 1900; Frequency: 1880 MHzFrequency: 1850.2 MHzFrequency: 1909.8 MHz;Duty Cycle: 1:8.3
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:

- Probe: AM1DV2 - 1016; ; Calibrated: 19/04/2007
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn473; Calibrated: 18/01/2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Scans/x (longitudinal) 24 x 16/ABM Signal(x,y,z) (13x9x1):
Measurement grid: dx=2mm, dy=2mm
Cursor:
ABM1 comp = -17.4565 dB A/m
BWC Factor = 0.007727 dB
Location: -8, -2, 363.7 mm

Point measurement 2/x (longitudinal) at max x/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -17.78 dB A/m
BWC Factor = 0.00737987 dB
Location: -10, -4, 363.7 mm

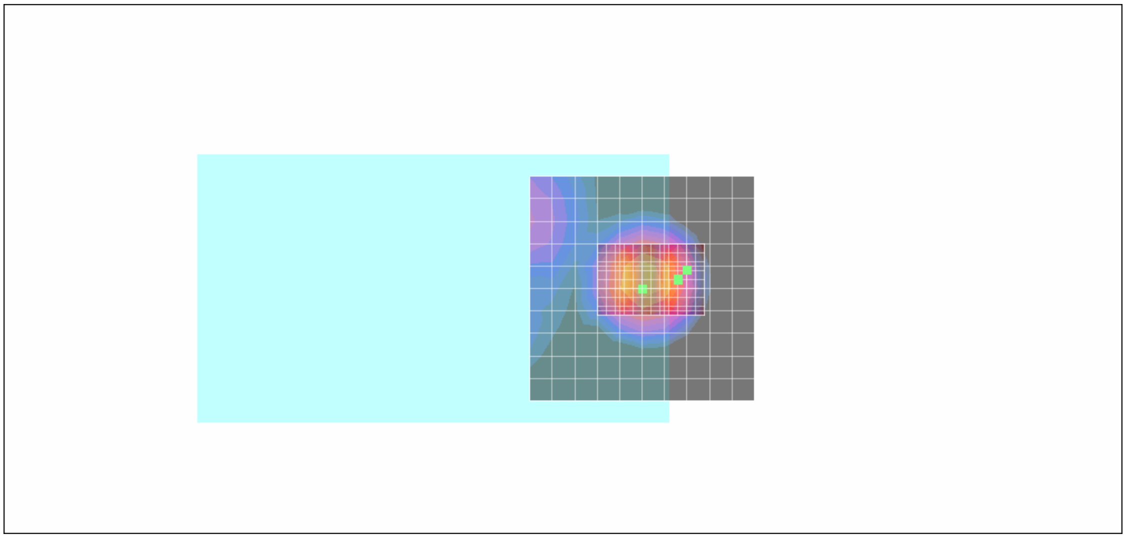
Point measurement 2/x (longitudinal) at max x/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -28.657 dB A/m
Location: -10, -4, 363.7 mm

Point measurement 2/x (longitudinal) at max x/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 10.877 dB
BWC Factor = 0.00737987 dB
Location: -10, -4, 363.7 mm

Point measurement 3/x (longitudinal) at max x/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -17.7692 dB A/m
BWC Factor = 0.00711951 dB
Location: -10, -4, 363.7 mm

Point measurement 3/x (longitudinal) at max x/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -29.3199 dB A/m
Location: -10, -4, 363.7 mm

Point measurement 3/x (longitudinal) at max x/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 11.5507 dB
BWC Factor = 0.00711951 dB
Location: -10, -4, 363.7 mm



0 dB = 1.00A/m

Date/Time: 14/06/2007 11:54:22 AM

Test Laboratory: RTS

HAC_TCoil_GSM1900_radial_T

DUT: BlackBerry Smartphone; Type: Sample ; Serial: Not Specified

Communication System: GSM 1900; Frequency: 1880 MHzFrequency: 1850.2 MHzFrequency: 1909.8 MHz;Duty Cycle: 1:8.3
Medium parameters used: σ = 0 mho/m, ε_r = 1; ρ = 1 kg/m^3
Phantom section: AMB with Coil Section

DASY4 Configuration:

- Probe: AM1DV2 - 1016; ; Calibrated: 19/04/2007
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn473; Calibrated: 18/01/2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 100x
- Measurement SW: DASY4, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

Scans/y (transversal) 16 x 24/ABM Signal(x,y,z) (9x13x1):
Measurement grid: dx=2mm, dy=2mm
Cursor:
ABM1 comp = -17.7641 dB A/m
BWC Factor = 0.007727 dB
Location: 0, -10, 362.7 mm

Point measurement/y (transversal) at max y/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -17.5309 dB A/m
BWC Factor = 0.0072063 dB
Location: 0, -10, 362.7 mm

Point measurement/y (transversal) at max y/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -31.2381 dB A/m
Location: 0, -10, 362.7 mm

Point measurement/y (transversal) at max y/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 13.7072 dB
BWC Factor = 0.0072063 dB
Location: 0, -10, 362.7 mm

Point measurement 2/y (transversal) at max y/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -17.4909 dB A/m
BWC Factor = 0.00737987 dB
Location: 0, -10, 362.7 mm

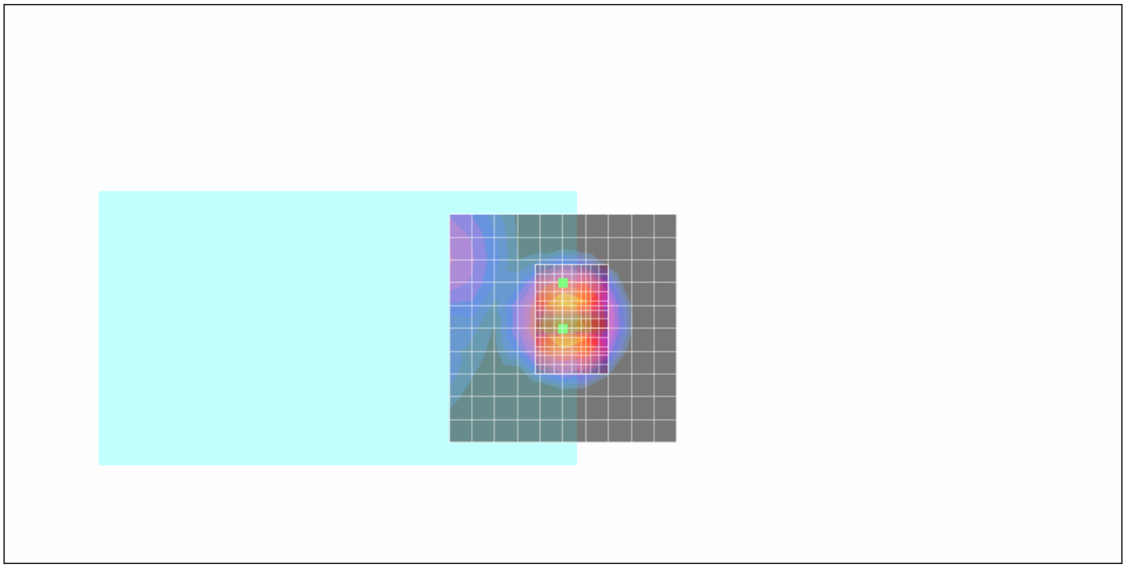
Point measurement 2/y (transversal) at max y/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -31.0553 dB A/m
Location: 0, -10, 362.7 mm

Point measurement 2/y (transversal) at max y/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 13.5644 dB
BWC Factor = 0.00737987 dB
Location: 0, -10, 362.7 mm

Point measurement 3/y (transversal) at max y/ABM Signal(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1 comp = -17.5136 dB A/m
BWC Factor = 0.00711951 dB
Location: 0, -10, 362.7 mm

Point measurement 3/y (transversal) at max y/ABM Noise(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM2 = -31.1595 dB A/m
Location: 0, -10, 362.7 mm

Point measurement 3/y (transversal) at max y/ABM SNR(x,y,z) (1x1x1):
Measurement grid: dx=10mm, dy=10mm
Cursor:
ABM1/ABM2 = 13.646 dB
BWC Factor = 0.00711951 dB
Location: 0, -10, 362.7 mm



0 dB = 1.00A/m

Annex D: Probe certificate and equipment spec

Schmid & Partner Engineering AG

s p e a g

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info@speag.com, http://www.speag.com

Client RIM

Certificate of test and configuration

Item	**AM1DV2** Audio Magnetic 1D Field Probe
Type No	SP AM1 001 AC
Series No	**1016**
Manufacturer / Origin	Schmid & Partner Engineering AG, Zürich, Switzerland

Description of the item
The Audio Magnetic Field Probe is a fully shielded magnetic field probe for the frequency range from 100 Hz to 20 kHz. The pickup coil is compliant with the dimensional requirements of [1]. The probe includes a symmetric 40dB low noise amplifier for the signal available at the shielded 3 pin connector at the side. Power is supplied via the same connector (phantom power supply) and monitored via the LED near the connector. The 7 pin connector at the end of the probe does not carry any signals, but determines 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 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 the DASY4 system, the probe must be operated with the special probe cup provided (larger diameter).

Functional test, configuration data and sensitivity
The probe configuration data were evaluated after a functional test including noise level and RF immunity. Connector rotation, sensor angle and sensitivity are specific for this probe.

DASY4 configuration data for the probe

Configuration item	Condition	Configuration Data	Dimension
Overall length	mounted on DAE in DASY4 system	296	mm
Tip diameter	at the cylindrical part	6	mm
Sensor offset	center of sensor, from tip	3	mm
Connector rotation	Evaluated in homogeneous 1 kHz magnetic field generated with AMCC Helmholtz Calibration Coil	**252.5**	°
Sensor angle		**3.34**	°
Sensitivity	at 1 kHz	**0.0657**	V / (A/m)

Standards
[1] ANSI-C63.19-2006

Test date 19.04.2007

Issue date 19.04.2007

Signature i.V. [signature]

Doc No 884 – SP AM1 001 A – 1016 – 070419 – F Page 1 (1)

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Certificate of conformity

Item	Audio Magnetic Calibration Coil AMCC
Type No	**SD HAC P02 A**
Series No	1001 ff.
Manufacturer / Origin	Schmid & Partner Engineering AG Zurich, Switzerland

Description of the item
The Audio Magnetic Calibration coil (AMCC) is a Helmholtz Coil designed according to standard [1], section D.9 for calibration of the AM1D probe. Two horizontal coils are positioned above a non-metallic base plate and generate a homogeneous magnetic field in the z direction (normal to it).

Configuration
The AMCC consists of two parallel coils of 20 turns with radius 143 mm connected in parallel in a distance of 143 mm. With this design, a current of 10 mA produces a field of 1 A/m.
The DC input resistance at the input BNC socket is adjusted by a series resistor to a DC resistance of approximately 50 Ohm. The voltage required to produce a field of 1 A/m is consequently approx. 500 mV.
To current through the coil is monitored via a shunt resistor of 10 Ohm +/- 1%. The voltage is available on a BNO socket with 100 mV corresponding to 1 A/m.

Handling of the item
The coil shall be positioned in a non-metallic environment to avoid distortion of the magnetic field.

Tests

Test	Requirement	Details	Units tested
Number of turns	N = 20 per coil	Resistance measurment	all
Orientation of coils	parallel coils with same direction of windings	Magnetic field variation in the AMCC axis	all
Coil radius	r = 143 mm	mechanical dimension	First article
Coil distance	d = 143 mm distance between coil centers	mechanical dimension	First article
Input resistance	51.7 +/- 2 Ohm	DC resistance at BNC input connector	all
Shunt resistance	R = 10.0 Ohm +/- 1 %	DC resistance at BNO output connector	all
Shunt sensitivity	Hc = 1 A/m per 100 mV according to formula Hc = (U / R) * N / r / (1.25^1.5)	Field measurement compared with Narda ELT400 + BN2300/90.10	First article

Standards

[1] ANSI PC63.19-2006 Draft 3.12

Conformity
Based on the tests above, we certify that this item is in compliance with the requirements of [1].

Date 22.5.2006

Stamp / Signature

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Doc No 880 – SD HAC P02 A – A Page 1 (1)

Specifications

Audio Magnetic Field Probe AM1D

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. The compliance 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 it includes the probe preamplifier and also with the AMMI internal preamplifiers, filters and processing.

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

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

Audio Magnetic Measurement Instrument (AMMI)
sampling rate 48 kHz / 24 bit
dynamic range 85 dB
test signal generation user selectable and predefined (via PC)
calibration auto-calibration / full system calibration using AMCC
with monitor output
dimensions 482 x 65 x 270 mm

Helmholtz Calibration Coil (AMCC)
dimensions 370 x 370 x 196 mm, according to ANSI-PC63.19
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