





Hearing Aid Compatibility (HAC) T-COIL ENGINEER REPORT

For

Verykool USA Inc.

4350 Executive Dr. #100
San Diego, USA

FCC ID: WA6R23

Report Type: Original Report	Product Type: GSM Mobile Phone
Test Engineer:	Arthur Tie 
Report Number:	R1109169-HAC-T
Report Date:	2011-12-12
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* This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk "*" Rev. 2

HEARING AID COMPATIBILITY DECLARATION OF COMPLIANCE	
FCC Rule Part(s):	CFR 47 §20.19
HAC Test Procedure(s):	ANSI C63.19-2007
Device Category:	Portable Transmitter Held to Ear
Modulation Type:	GMSK
TX Frequency Range:	824-849 MHz (Cellular Band) 1850-1910 MHz (PCS Band)
HAC Test Configurations:	Cellular, 824.2 836.6 848.8, BT Off, Max Hand free, Backlight Off PCS, 1850.2 1880 1909.8, BT Off, Max Hand free, Backlight Off
EUT Type:	Cellular/PCS Phone with Bluetooth
Maximum Conducted Power Tested:	32.97 dBm (Cellular Band) 29.39 dBm (PCS Band)
Battery Type (s) Tested:	3.8 V
Overall HAC Rating	M3/T3

T Category = T3 (ANSI C63.19-2007)

BACL Corp. declares under its sole responsibility that this wireless portable device has been tested for Hearing Aid Compatibility in accordance with the measurement procedures specified in ANSI C63.19-2007.

All measurements reported herein were performed under my supervision and believed to be accurate to the best of my knowledge. I further attest for the completeness of these measurements and vouch for the qualifications any and all personnel performing such measurements.

The results and statements contained in this report pertain only to the device(s) evaluated.

Approved by:

VICTOR ZHANG
EMC/RF LEAD



Air Interfaces

Air-Interface	Band (MHz)	Type	C63.19 tested	Simultaneous Transmissions (Not to be tested)	Reduced power	VOIP
GSM	850	Voice	Yes	Yes: BT	N/A*	YES
	1900				N/A*	YES
BT	2450	Data	N/A*	Yes: GSM	N/A*	N/A*
<p>* HAC Rating was not based on concurrent voice and data modes. Non current mode was found to represent worst case rating for both M and T rating.</p>						

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1109169-HAC-T	Original Report	2011-12-12

1 GENERATION INFORMATION

1.1 Product Description for the EUT

This Bay Area Compliance Laboratories Corp.(Shenzhen) test report has been prepared on behalf of *Verykool USA Inc.*, and their product GSM Mobile Phone, Model: R23, or the EUT (Equipment Under Test,) as referred to in the rest of this report.

The test data gathered are from typical production sample, serial number: R1109169-1, provided by BACL Corp.(Shenzhen)

Item	Content
Modulation	GMSK
Frequency Band	Cellular Band: 824-849 MHz PCS Band: 1850-1910 MHz
Dimensions (L x W x H)	110 mm (L) x 50 mm (W) x 20 mm (H)
Weight	78.0 g
Power Source	3.8 V
Operation Mode	Head & Body-worn

1.2 Objective

The objective is to determine compliance with FCC rules for Hearing Aid Compatibility (HAC) using ANSI/IEEE Std. C63.19-2007 (American National Standard Method of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids) and test in accordance with the specified measurement procedures.

1.3 Test Facilities and Accreditation

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect data is located at 6/F, the 3rd Phase of WanLi Industrial Building, Shi Hua Road, Fu Tian Free Trade Zone, Shenzhen, Guangdong, P.R. of China

Additionally, Bay Area Compliance Laboratories Corp. (Shenzhen) is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200707-0).



The current scope of accreditations can be found at <http://ts.nist.gov/Standards/scopes/2007070.htm>

2 DESCRIPTION OF TEST SYSTEM

2.1 T-Coil Measurement System

The figure below shows the phantom set up in a DASY4 system. The Helmholtz Audio Magnetic Calibration Coil (AMCC) is mounted on the same plane as the HAC Test Arch phantom available from the HAC RF extension. Both items fit together without additional fixation and are arranged side by side. In place of a separate table, the cover plate of a SAM phantom may be used.

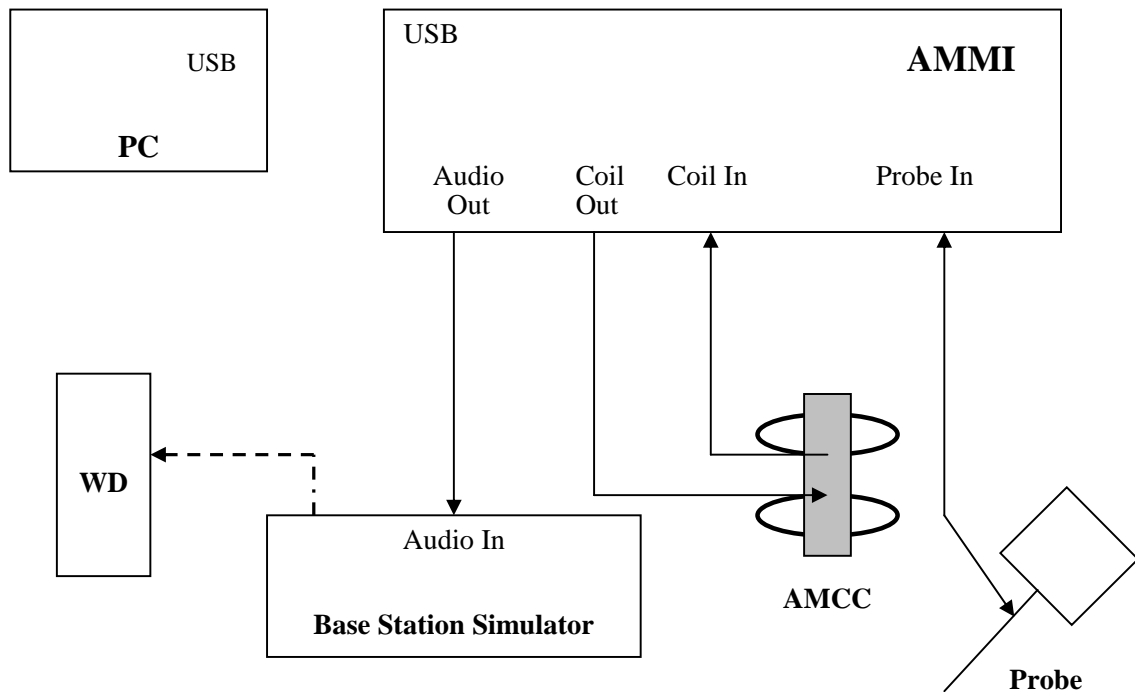


T-Coil Setup with HAC Test Arch and AMCC

The DASY4 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A Data Acquisition Electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-Optical Converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.

- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.
- DASY4 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The device holder for handheld mobile phones.
- Dipole for evaluating the proper functioning of the system.
- Arch Phantom.



T-Coil Setup Cabling

2.2 System Components

- DASY4 Measurement Server
- Data Acquisition Electronics
- Probes
- Light Beam Unit
- Medium
- SAM Twin Phantom, Arch Phantom
- Device Holder for SAM Twin Phantom
- System Validation Kits
- Robot

2.3 DASY4 Measurement Server

The DASY4 measurement server is based on a PC/104 CPU board with a 166MHz low-power Pentium, 32MB chip disk and 64MB RAM. The necessary circuits for communication with either the DAE4 (or DAE3) electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY4 I/O-board, which is directly connected to the PC/104 bus of the CPU board.



The measurement server performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. The PC-operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with two expansion slots which are reserved for future applications. Please note that the expansion slots do not have a standardized pinout and therefore only the expansion cards provided by SPEAG can be inserted. Expansion cards from any other supplier could seriously damage the measurement server.

2.4 Data Acquisition Electronics (DAE)

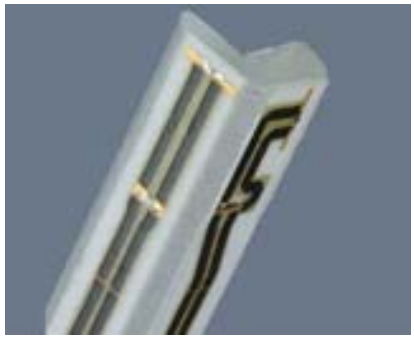
The data acquisition electronics DAE3 consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.




2.5 E-Field and H-Field Probes

The HAC measurement is conducted with the dosimetric probe ER3DV6 and H3DV6 (manufactured by SPEAG). The probe is specially designed and calibrated. This probe has a built in optical surface detection system from collision with DUT.

ER3DV6 E-Field Probe Description

Construction	One dipole parallel, two dipoles normal to probe axis Built-in shielding against static charges PEEK enclosure material	 <p style="text-align: center;">E-Filed Free-space Probe (ER3DV6)</p>
Calibration	In air from 100 MHz to 3.0 GHz (absolute accuracy $\pm 6.0\%$, $k=2$)	
Frequency	40 MHz to > 6 GHz (can be extended to < 20 MHz) Linearity: ± 0.2 dB (100 MHz to 3 GHz)	
Directivity	± 0.2 dB in air (rotation around probe axis) ± 0.4 dB in air (rotation normal to probe axis)	
Dynamic Range	2 V/m to > 1000 V/m; Linearity: ± 0.2 dB	
Dimensions	Overall length: 330 mm (Tip: 16 mm) Tip diameter: 8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.5 mm	
Application	General near-field measurements up to 6 GHz Field component measurements Fast automatic scanning in phantoms	

H3DV6 H-Field Probe Description

Construction	Three concentric loop sensors with 3.8 mm loop diameters Resistively loaded detector diodes for linear response Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., glycoether)	 <p style="text-align: center;">H-Filed Free-space Probe (H3DV6)</p>
Frequency	200 MHz to 3 GHz (absolute accuracy $\pm 6.0\%$, $k=2$); Output linearized	
Directivity	± 0.2 dB (spherical isotropy error)	
Dynamic Range	10 mA/m to 2 A/m at 1 GHz	
E-Field Interference	< 10% at 3 GHz (for plane wave)	
Dimensions	Overall length: 330 mm (Tip: 40 mm) Tip diameter: 6 mm (Body: 12 mm) Distance from probe tip to dipole centers: 3 mm	
Application	General magnetic near-field measurements up to 3 GHz (in air or liquids) Field component measurements Surface current measurements Low interaction with the measured field	

2.6 Probes Tip Description

HAC field measurements take place in the close near field gradients. Increasing the measuring distance from the source will generally decrease the measured field values (in case of the validation dipole approx. 10% per mm)

Magnetic field sensors are measuring the integral of H-field across area surrounded by the loop. They are calibrated in a precise, homogeneous field. When measuring a gradient field, the result will be very close to the field in the center of the loop which is equivalent to the value of a homogeneous field equivalent to the center value. But it will be different from the field at the edge of the loop.

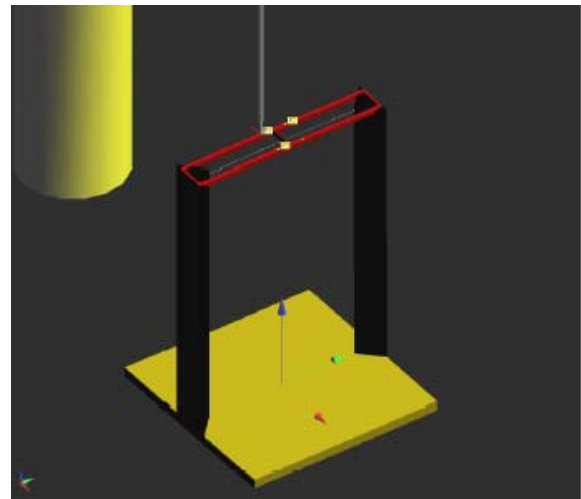
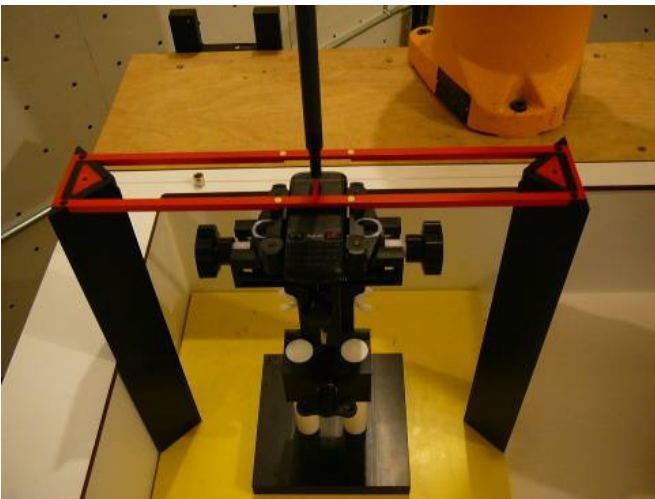
Consequently, two sensors with different loop diameters – both calibrated ideally- would give different results when measuring from the edge of probe of the probe sensor elements. The behavior for electronically small E-field sensors is equivalent.

The magnetic field loops of the H3D probes are concentric, with the center 3 mm from the tip for H3DV6.

The electric field probes have a more irregular internal geometry because it is physically not possible to have the 3 orthogonal sensors situated with the same center. The different sensor center is accounted for in HAC uncertainty budget (“sensor displacement”). Their geometric center is at 2.5 mm from the tip, and the element ends are 1.1 mm closer to the tip.

2.7 Device Holder and Phantom

The test Arch phantom should be positioned horizontally on a stable surface. Reference marking on the phantom allows the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.



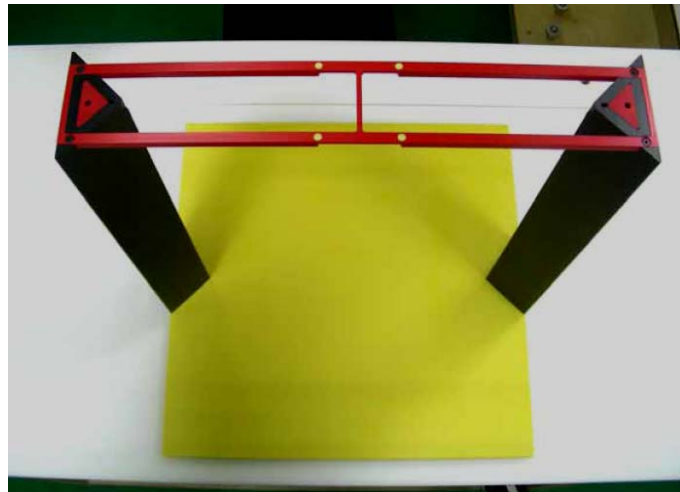
The DASY device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\epsilon_r=3$ and loss tangent $\tan \delta=0.02$. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

2.8 Light Beam Unit

The light beam switch allows automatic “tooling” of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, so that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.

2.9 Device Holder and Arch Phantom

The test Arch phantom should be positioned horizontally on a stable surface. Reference marking on the phantom allows the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

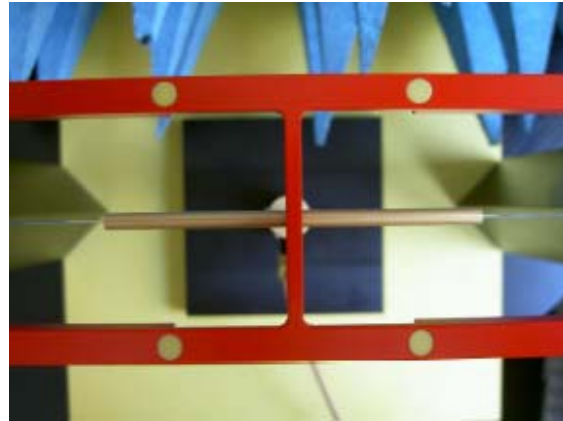


2.10 Installation of the Test Arch Phantom

The Test Arch phantom should be positioned horizontally on a stable surface. If the cover of the Twin SAM phantom is used, side shifting after the teaching shall be avoided. In order to allow a vertical position of the probe (for both DASY4 Professional and Compact versions) the section Park position should be not higher than 15mm above the top of the upper Arch frame. For improved user friendliness a predefined configuration file of the Test Arch phantom is provided by SPEAG.

2.11 Mounting of a Calibration Dipole

A set of three calibration dipoles (CD835, CD1880 and CD2450) is included as a part of the HAC extension. These are used for the validation of the test setup after its installation and prior to the DUT measurements. The calibration dipole is placed in the position normally occupied by the DUT. All three calibration dipoles have the same high which allows an exact fitting below the center point of the Test Arch.



Insert the base of the calibration dipole fully into the dipole holder and fix it against rotation by tightening the white screw. Connect the RF cable to the dipole and secure it before placing it below the Test Arch phantom in order to avoid mechanical stress to it. Hold the dipole on its plate at the base and press it down against the internal spring to reduce the height.

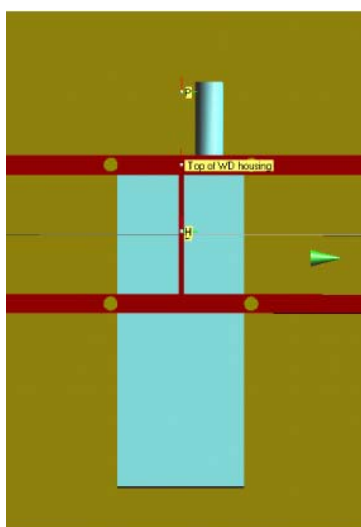
While holding the dipole down, slide the dipole on its holder centered below the arch, with the arms aligned to the dielectric wire (see graphics above). Release the dipole slowly and guide the gap between the arms into the matching center spacer below the dielectric wire.

To remove the dipole from the setup press it in the downwards direction before sliding it carefully out from below the arch.

2.12 Mounting the DUT

A DUT is mounted in the device holder equivalent as for classic dosimetric measurements. The acoustic output of the DUT shall coincide with the center point of the area formed by the dielectric wire and the middle bar of the arch's top frame (see picture below).

The DUT shall be moved vertically upwards until it touches the frame. The fine adjustment is possible by sliding the complete DUT holder on the yellow base plate of the Test Arch phantom.



2.13 Robot

The DASY4 system uses the high precision industrial robots RX60L, RX90 and RX90L, as well as the RX60BL and RX90BL types out of the newer series from Stäubli SA (France). The RX robot series offers many features that are important for our application:

- High precision (repeatability 0.02mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance-free due to direct drive gears; no belt drives)
- Jerk-free straight movements (brushless synchrony motors; no stepper motors)
- Low ELF interference (the closed metallic construction shields against motor control fields)

For the newly delivered DASY4 systems as well as for the older DASY3 systems delivered since 1999, the CS7MB robot controller version from Stäubli is used. Previously delivered systems have either a CS7 or CS7M controller; the differences to the CS7MB are mainly in the hardware, but some procedures in the robot software from Stäubli are also not completely the same. The following descriptions about robot hard- and software correspond to CS7MB controller with software version 13.1 (edit S5). The actual commands, procedures and configurations, also including details in hardware, might differ if an older robot controller is in use. In this case please also refer to the Stäubli manuals for further information.

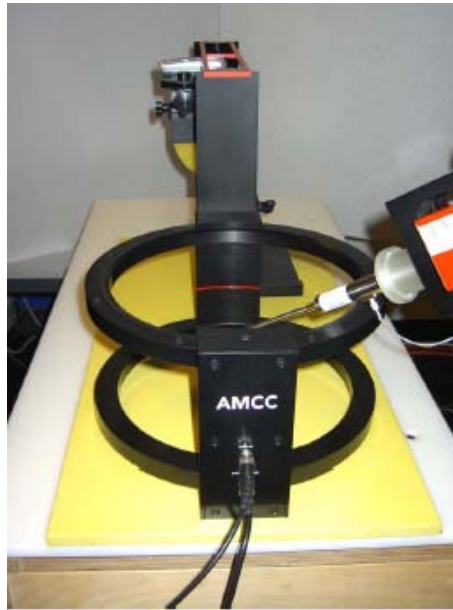


2.14 AMCC

The Audio Magnetic Calibration Coil (AMCC) is a Helmholtz Coil designed for calibration of the AMID probe. Two horizontal coils direction. The DC input resistance is adjusted by a series resistor to approximately 50 Ohm, and a shunt resistor of 10 Ohm permits monitoring the current with a scale of 1:10.

AMCC Port Description:

Signal	Connector Type	Resistance
Coil In	BNC	50 Ohm
Coil Monitor	BNO	10 Ohm \pm 1%



2.15 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.

Signal	Connector Type	Description
Audio Out	BNC	Audio signal to the base station simulator, for >500Ohm 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, 600Ohm
Probe In	XLR	Probe signal and phantom supply to the probe Lemo connector



2.16 AM1D Probe

The AM1D probe is an active probe with a single sensor. It is fully RF-shielded and has a rounded tip 6mm in diameter incorporating a pickup coil with its center offset 3mm from the tip and the sides. The symmetric signal preamplifier in the probe is fed via the shielded symmetric output cable from the AMMI with a 48V “phantom” voltage supply. The 7-pin connector on the back in the axis of the probe does not carry any signals. It is mounted to the DAE for the correct orientation of the sensor. If the probe axis is tilted 54.7 degree from the vertical, the sensor is approximately vertical when the signal connector is at the underside of the probe (cable hanging downwards).

The sensor axis is indicated by a dot at the probe tip. AM1D probes are available with 40 dB or 20dB internal amplification factors depending on the required dynamic range.



During operation in DASY4, the DAE must be switched on to provide the touch and emergency stop signals. The matching probe cup gives higher stability during tilted movements and rotation, still permitting the necessary movement for surface detection and the emergency stop function. Fix the probe tightly to the DAE, so the probe body cannot be turned against the DAE. In order to avoid breaking the DAE pins, only turn the connector nut, never the probe body! Make sure the probe can move correctly along its axis for surface detection.

3 TESTING EQUIPMENT LIST AND DETAILS

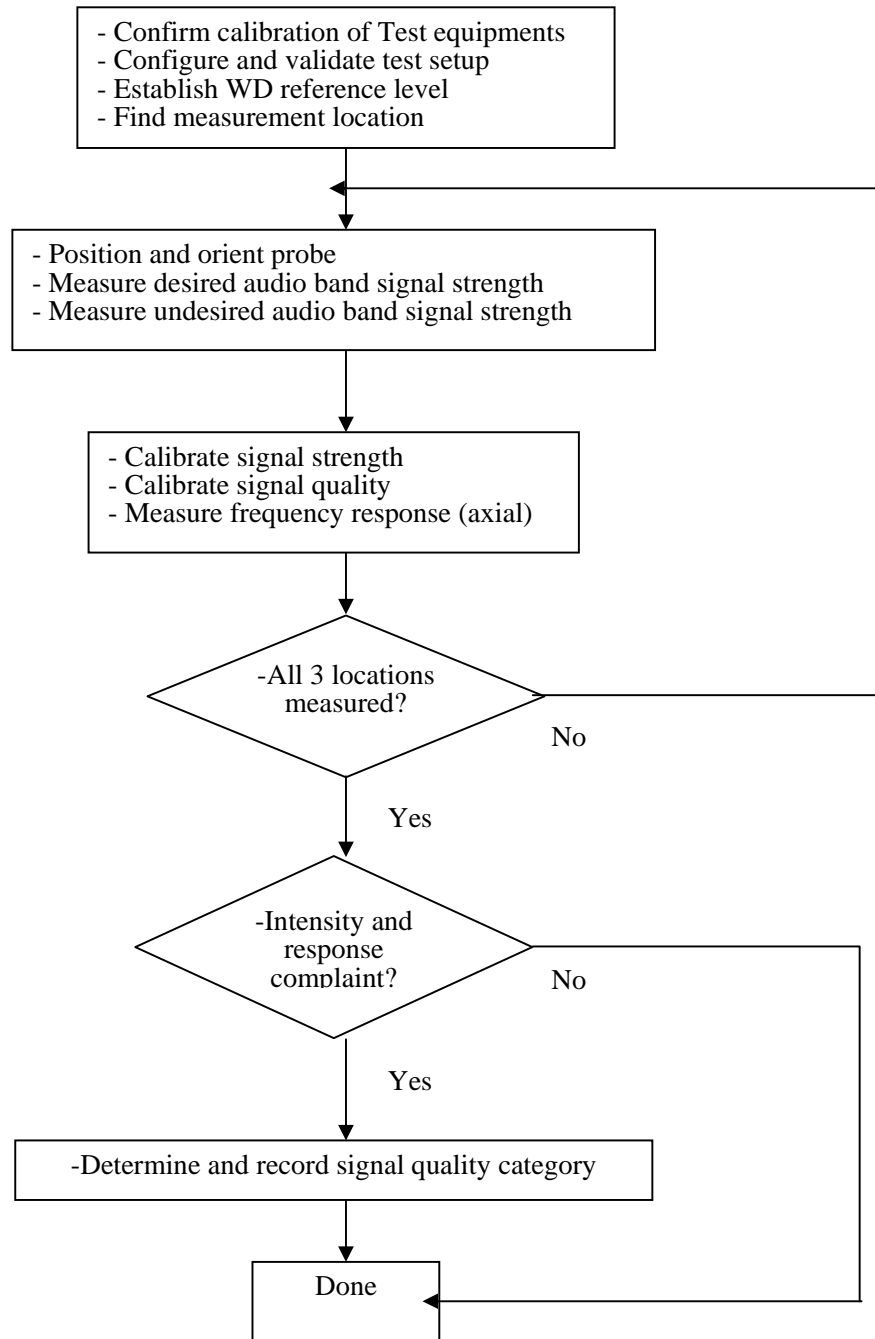
Type / Model	Calibration Due Date	S/N:
DASY4 Professional Dosimetric System	N/A	N/A
Robot RX60L	N/A	CS7MBSP / 467
Robot Controller	N/A	F01/5J72A1/A/01
Dell Computer Dimension 3000	N/A	N/A
SPEAG EDC3	N/A	N/A
SPEAG DAE3	2011-12-07	456
Audio Magnetic 1 D Probe, AM1DV2*	2012-09-18	1073
SPEAG Arch Phantom	N/A	1010
SPEAG Light Alignment Sensor	N/A	278
Audio Magnetic Calibration Coil, AMCC*	2012-08-28	1081
Audio Measuring Instrument, AMMI*	2012-08-28	1071
Agilent, Spectrum Analyzer E4440A	2012-08-09	US45303156
Analyzer Communication, CMU200	2013-06-29	103492
Dielectric Probe Kit HP85070A	N/A	US99360201
Rohde & Schwarz, Signal Generator, SMIQ03	2012-03-31	849192/0085
Amplifier, ST181-20	N/A	E012-0101
Antenna, Horn, EMCO	2012-09-09	3115
Power Meter Agilent E4419B	2012-09-01	MY4121511
Power Sensor Agilent E9301A	2012-02-19	US39211706
Dielectric Probe Kit HP85070A	N/A	US99360201

Note: "Audio Magnetic 1 D Probe, AM1DV2", "Audio Magnetic Calibration Coil, AMCC", and "Audio Measuring Instrument, AMMI extended calibration cycle to three years.

4 HAC T-TOIL TEST METHOD AND PROCEDURE

4.1 Test Procedure

According to ANSI C63.19-2007, the device should be tested as the flowchart hereinafter.



T-Coil Measurement flowchart

4.2 Articulation Weighting Factor (AWF)

The following AWF factors shall be used for the standard transmission protocols:

Standard	Technology	AWF (dB)
TIA/EIA/IS-2000	CDMA	0
TIA/EIA-136	TDMA (50 Hz)	0
J-STD-007	GSM (217)	-5
T1/P1P1/3GPP	UMTS (WCDMA)	0
iDEN	TDMA (22 and 11 Hz)	0

4.3 T-Coil Signal Quality Categories

The RF measurements made for the T-Coil evaluation are used to assign the category T1 through T4. The limitation is given in the table below. This establishes the RF environment presented by the WD to hearing aid.

Category	Telephone Parameters WD signal quality [(signal+noise)-to-noise ratio in dB]
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

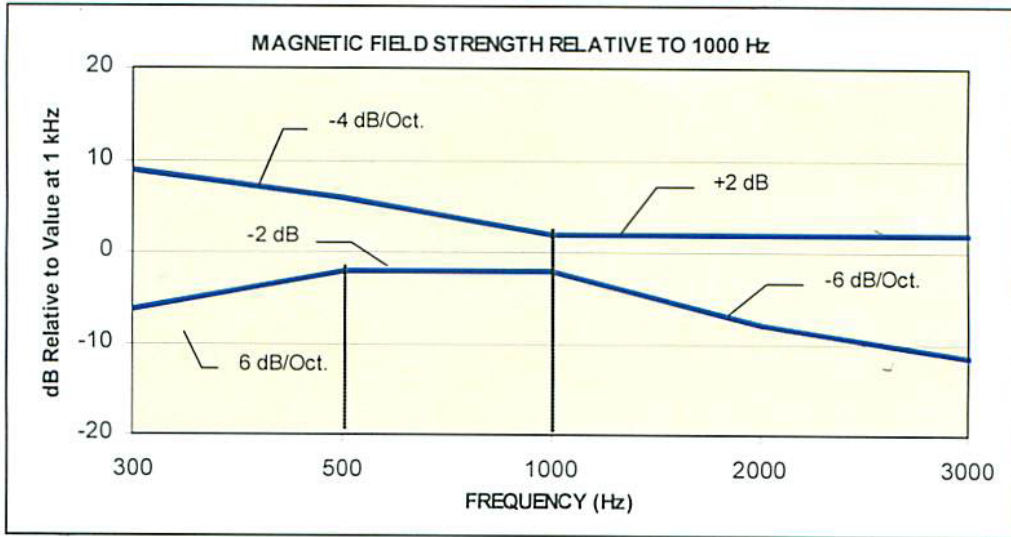
4.4 Test Flow for T-Coil Signal Test

The following steps summarize the basic test flow for determining ABM1 and ABM2. These steps assume that a sine wave or narrowband 1/3 octave signal can be used for the measurement of ABM1. An alternate procedure yielding equivalent results utilizing a broadband excitation is described in 6.4 of ANSI 63.19-2007.

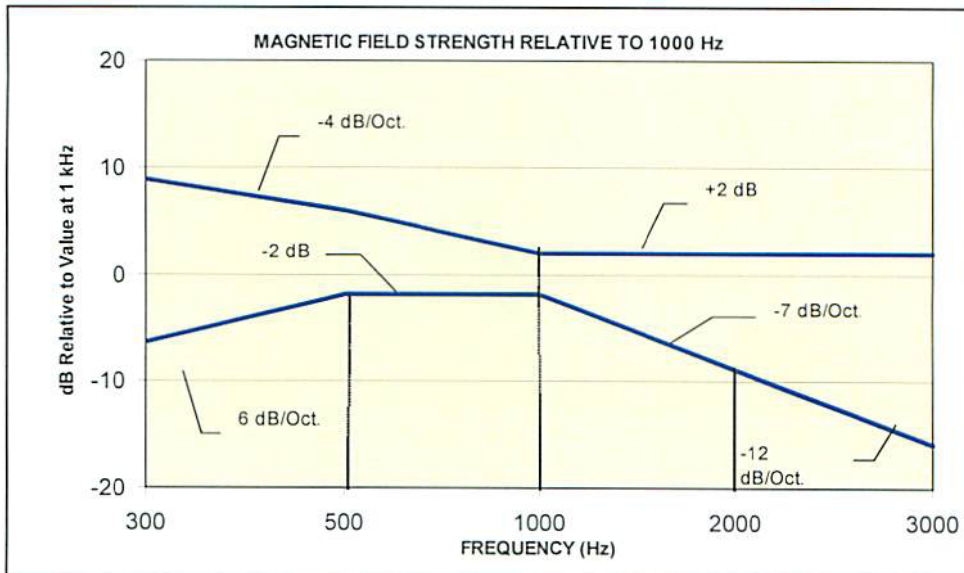
1. A reference check of the test setup and instrumentation may be performed using a TMFS. Position the TMFS into the setup at the position to be occupied by the WD. Measure the emissions from the TMFS and confirm that they are within the tolerance of the expected values.
2. Position the WD in the test setup and connect WD RF connector to a base station simulator or a non-radiating load as Figure 6.1 and Figure 6.2 of ANSI 63.19-2007. Confirm that equipment that requires calibration has been calibrated, and that the noise level meets the requirements given in 6.2.1 of ANSI 63.19-2007.
3. The drive level to the WD is set such that the reference input level defined in 6.3.2.1, Table 6.1 of ANSI 63.19-2007 is input to the base station simulator (or manufacturer's test mode equivalent) in the 1 kHz, 1/3 octave band. This drive level shall be used for the T-Coil signal test (ABM1) at $f = 1$ kHz. Either a sine wave at 1025 Hz or a voice-like signal, band-limited to the 1 kHz 1/3 octave, as defined in 6.3.2 shall be used for the reference audio signal. If interference is found at 1025 Hz an alternate nearby 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. The WD volume control may be set at any level up to maximum modulation would not result in clipping or signal overload.

4.5 Frequency Response

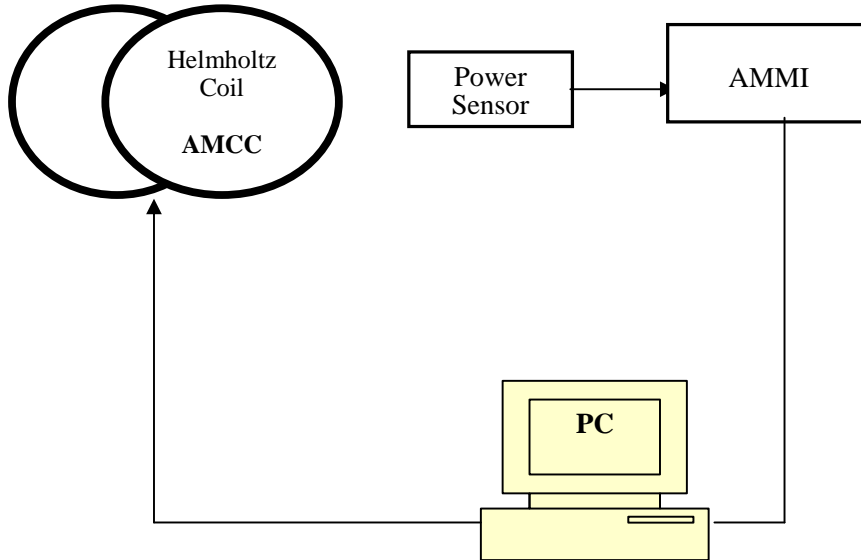
Magnetic field frequency response for wireless devices with an axial field between -10 dB to -13 dB (A/m) at 1 kHz



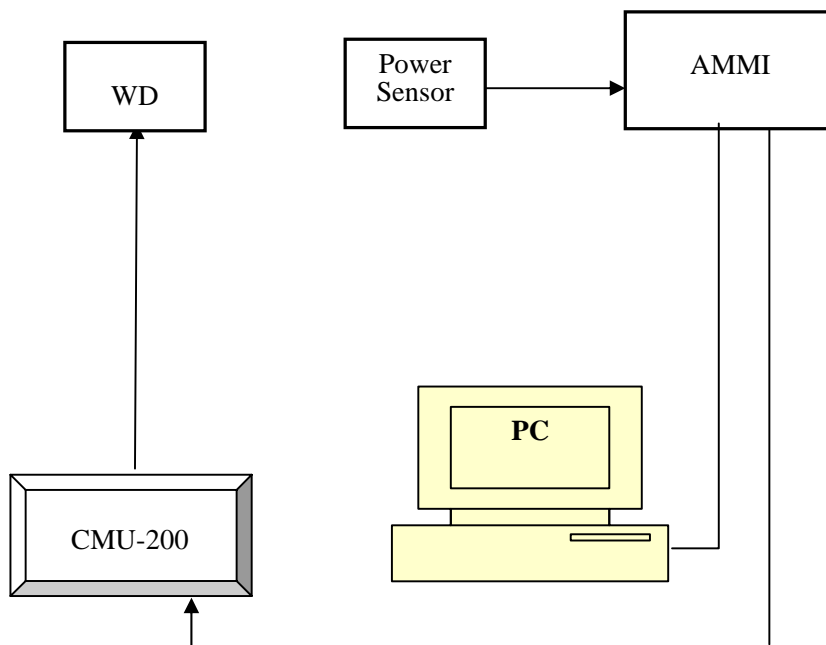
Magnetic field frequency response for wireless devices with an axial field that exceeds -10 dB (A/m) at 1 kHz



4.6 Test Setup

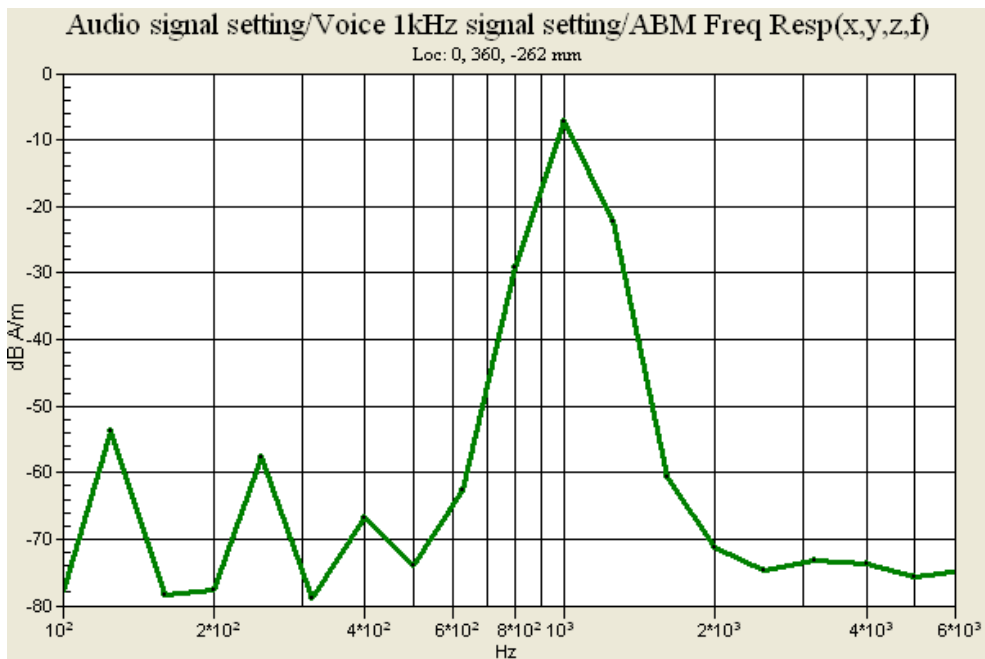
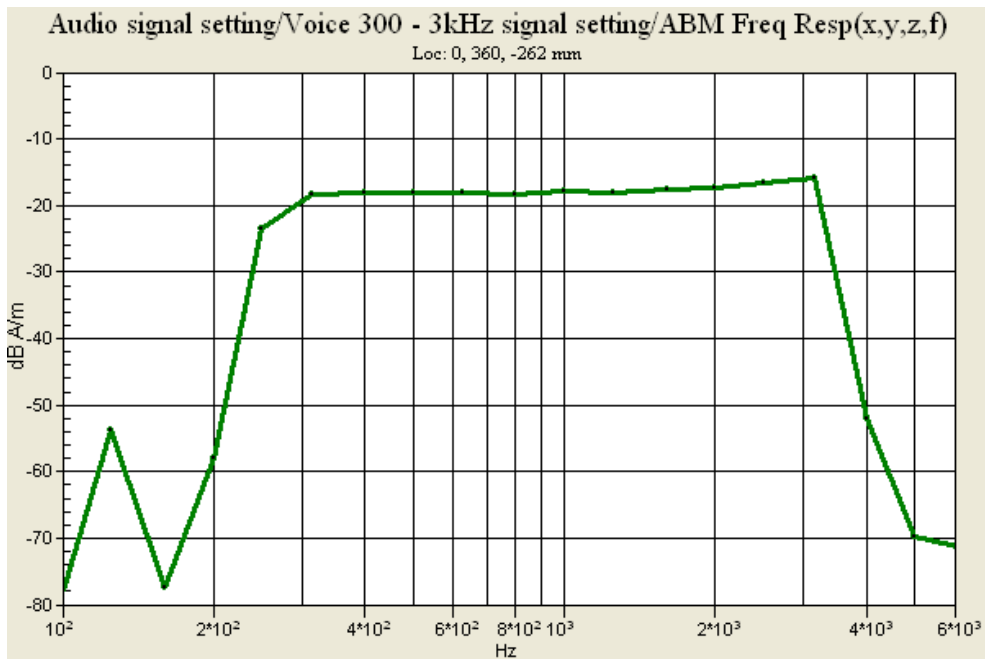


Validation Setup with Helmholtz Coil



T-Coil Test Setup

4.7 Reference Input of Audio Signal Spectrum



4.8 Signal Verification

According to ANSI C63.19:2007 §6.3.2.1, the following reference input levels that correlate to a normal speech input level shall be used for the standard transmission protocols:

Normal Speech Input Levels

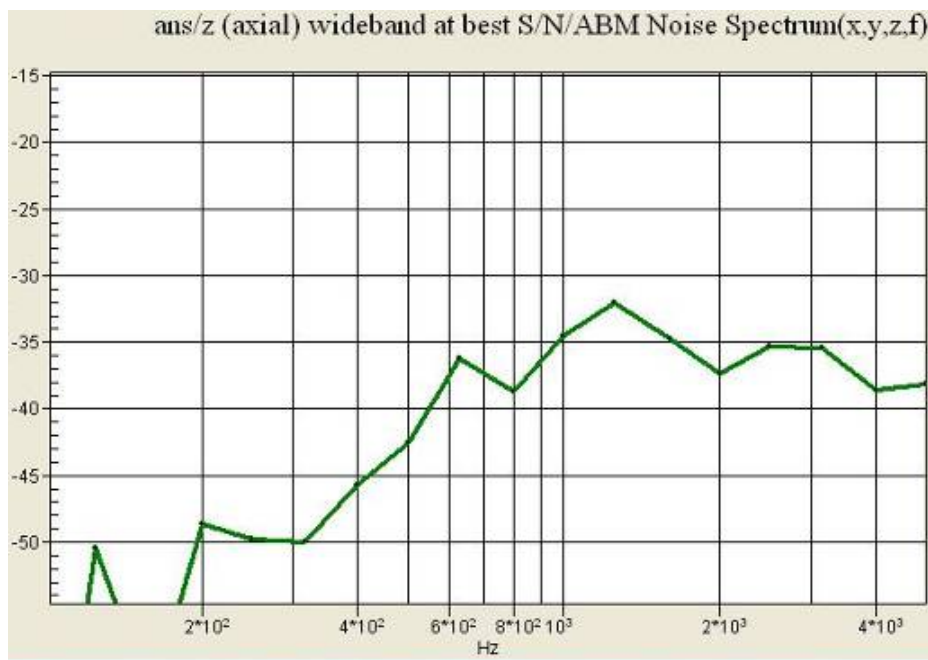
Standard	Technology	Input (dBm0)
TIA/EIA/IS-2000	CDMA	- 18
TIA/EIA-136	TDMA (50 Hz)	- 18
J-STD-007	GSM (217)	- 16
T1/PIPI/3GPP	UMTS (WCDMA)	- 16
iDEN	TDMA (22 and 11 Hz)	- 18

This technical note shows a possibility to evaluate and set the correct level with the HAC T-Coil setup with a Rohde & Schwarz communication tester CMU200 with audio option B52 and B58.

Establish a call from the CMU200 to a wireless device, select CMU200 Network Bitstream “Decoder Cal” to have a 1 kHz signal with a level of 3.14 dBm0 at the speaker output. Run the measurement job and read the voltage level at the multi-meter display “Coil signal”. Read the RMS voltage corresponding to 3.14 dBm0 and note it. Calculate the desired signal levels of -16 dBm0.

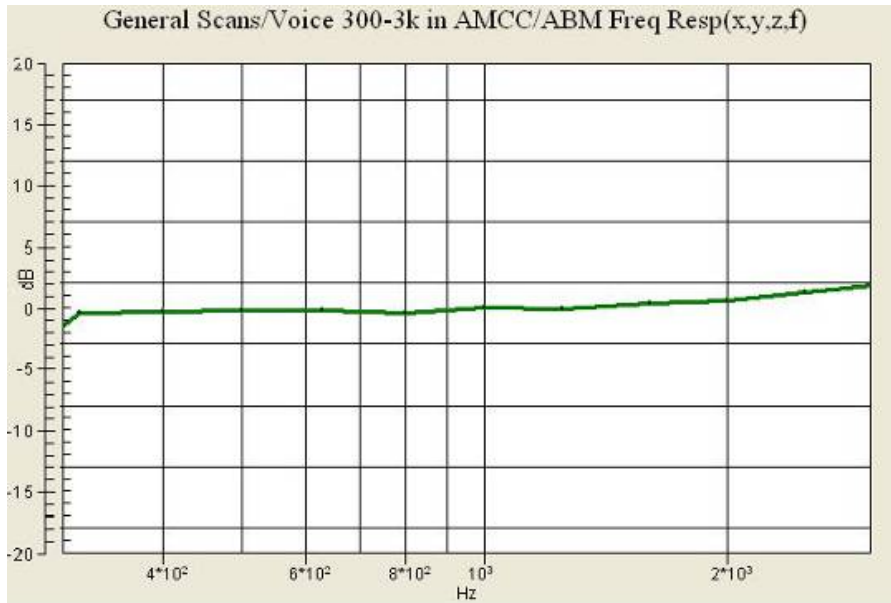
Determine the 1 kHz input level to generate the desired signal level of -16 dBm0. Select CMU200 Network Bitstream “Codec Cal” to loop the input via the codec to the output. Run the measurement job (AMMI 1 kHz signal with gain 10 inserted) and read the voltage level at the multi-meter display “Coil signal”. Calculate the required gain setting for the above levels.

4.9 Undesirable Audio Magnetic Band Plot (ABM2)



4.10 T-Coil Validation Test Results

2011-09-14



4.11 Helmholtz Coil Validation Table of Results

Item	Target	Measured dB About Target	Verdict
Signal Validation			
Frequency Response, from limits	0 + 0.5 dB	0.31	Pass
Noise Validation			
Axial Environment Noise	< - 38 dBA/m	-55.6	Pass
Radial H Environment Noise	< - 38 dBA/m	-54.82	Pass
Radial V Environment Noise	< - 38 dBA/m	-56.37	Pass

The Measurements indicate that the wireless communications device complies with the HAC limits specified in accordance with the ANSI C63.19 Standard. The tested device complies with the requirements in respect to all parameters specific to the test. The results and statements relate only to the item(s) tested.

The measurements system and techniques presented in this evaluation are proposed in the ANSI standard as a means of the best approximating wireless device compatibility with a hearing-aid. The literature is under continual re-construction.

5 HAC T-Coil MEASUREMENT RESULTS

5.1 Test Environment Conditions

Ambient Temperature:	20~23 °C
Relative Humidity:	43~48 %
ATM Pressure:	101~103kPa

Testing was performed by Arthur Tie on 2011-09-14 and 2011-09-15 in the SAR Chamber.

Table 1: Consolidated Table of worst-case Results

2011-09-14

C63.19 Sections	Mode	Band	Test Description	Minimum Limit* (dBA/m)	Measured (dBA/m)	T-Rating
7.3.1.1	GSM	Cellular	Intensity, Axial	-13	-12.55	-
7.3.1.2			Intensity, Radial H	-18	-11.63	-
7.3.1.2			Intensity, Radial V	-18	-11.98	-
7.3.3			Signal-to-Noise/Noise, Axial	5	32.03	T4
7.3.3			Signal-to-Noise/Noise, Radial H	5	20.78	T3
7.3.3			Signal-to-Noise/Noise, Radial V	5	25.20	T3
7.3.2			Frequency Response Axial	0		-

Note: The above summary table numerical values are based on the results from table 3

2011-09-15

C63.19 Sections	Mode	Band	Test Description	Minimum Limit* (dBA/m)	Measured (dBA/m)	T-Rating
7.3.1.1	GSM	PCS	Intensity, Axial	-13	-12.44	-
7.3.1.2			Intensity, Radial H	-18	-12.87	-
7.3.1.2			Intensity, Radial V	-18	-13.87	-
7.3.3			Signal-to-Noise/Noise, Axial	5	33.14	T4
7.3.3			Signal-to-Noise/Noise, Radial H	5	24.73	T3
7.3.3			Signal-to-Noise/Noise, Radial V	5	26.08	T3
7.3.2			Frequency Response Axial	0		-

Note: The above summary table numerical values are based on the results from table 3

Table 2: Consolidated Table of worst-case Results

	Volume Setting	GSM	PCS
Frequency Response Margin	Maximum *	Pass	Pass
Magnetic Intensity Verdict		Pass	Pass
FCC SNR Verdict		Pass	Pass

Note: The above table represents the pass/fail verdict according to data in table 3

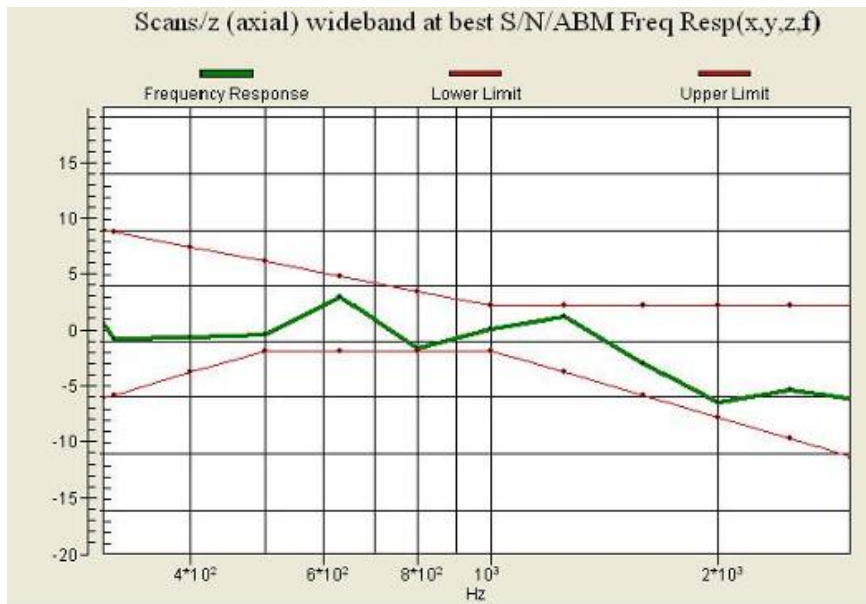
* Volume control to MAX.

Table 3: Raw Data Results

	Volume	Cellular Band								
		Axial			Radial H			Radial V		
		128	190	251	128	190	251	128	190	251
ABM1, dBA/m	Maximum *	-12.48	-12.16	-12.55	-11.1	-11.63	-11.18	-11.7	-11.98	-11.85
ABM2, dBA/m		-44.84	-45.44	-44.58	-31.88	-36.15	-37.58	-38.15	-41.54	-37.05
Ambient Noise, dBA/m		-56.07	-58.55	-56.07	-58.35	-58.35	-58.35	-56.78	-56.78	-56.78
Frequency Response Margin (dB)		0.22	0.17	0.23						
(S+N)/N (dB)		-32.36	-33.28	-32.03	-20.78	-24.52	-26.4	-26.45	-29.56	-25.20
(S+N)/N per orientation (dB)		32.03			20.78			25.20		
T-Rating		T4			T3			T3		
	Volume	PCS Band								
		Axial			Radial H			Radial V		
		512	661	810	512	661	810	512	661	810
ABM1, dBA/m	Maximum *	-10.02	-12.25	-12.44	-12.09	-12.42	-12.87	-11.94	-13.87	-11.97
ABM2, dBA/m		-47.37	-46.44	-45.58	-39.15	-37.15	-39.58	-39.15	-42.54	-38.05
Ambient Noise, dBA/m		-59.98	-57.39	-56.23	-56.77	-57.19	-56.14	-55.6	-54.82	-56.37
Frequency Response Margin (dB)		0.31	0.31	0.25						
(S+N)/N (dB)		-37.35	-34.19	-33.14	-27.06	-24.73	-26.71	-27.21	-28.67	-26.08
(S+N)/N per orientation (dB)		33.14			24.73			26.08		
T-Rating		T4			T3			T3		

Notes: 1) Power Configuration: PCL=5 (GSM850).
 2) Phone Condition: Mute on; Maximum volume *
 3) Voice Configuration: EFR

5.2 Frequency Response Plot



Note: This frequency response represents the worst-case ABM2 test configuration according to table3

6 APPENDIX A – PROBE CALIBRATION CERTIFICATES

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



S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **BACL**

Certificate No: **AM1DV2-1073_Sep08**

CALIBRATION CERTIFICATE

Object: **AM1DV2 - SN: 1073**

Calibration procedure(s): **QA CAL-24.v2
Calibration procedure for AM1D magnetic field probes and TMFS in the
audio range**

Calibration date: **September 18, 2009**

Condition of the calibrated item: **In Tolerance**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	03-Oct-07 (No: 6465)	Oct-08
Reference Probe AM1DV2	SN: 1008	23-Jan-08 (No: AM1D-1008_Jan08)	Jan-09
DAE4	SN: 781	2-Oct-07 (No: DAE4-781_Oct07)	Oct-08
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
AMCC	1050	15-Aug-08 (in house check Aug-08)	Aug-09

Calibrated by:	Name Mke Meili	Function RF Technician	Signature <i>M. Meili</i>
Approved by:	Name Fin Bornholt	Function R&D Director	Signature <i>F. Bornholt</i>

Issued: September 18, 2009

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

References

- [1] ANSI C63.19-2007
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.
- [2] DASY4 manual, Chapter: Hearing Aid Compatibility (HAC) T-Coil Extension

Description of the AM1D probe

The AM1D Audio Magnetic Field Probe is a fully shielded magnetic field probe for the frequency range from 100 Hz to 20 kHz. The pickup coil is compliant with the dimensional requirements of [1]. The probe includes a symmetric low noise amplifier for the signal available at the shielded 3 pin connector at the side. Power is supplied via the same connector (phantom power supply) and monitored via the LED near the connector. The 7 pin connector at the end of the probe does not carry any signals, but determines the angle of the sensor when mounted on the DAE. The probe supports mechanical detection of the surface.

The single sensor in the probe is arranged in a tilt angle allowing measurement of 3 orthogonal field components when rotating the probe by 120° around its axis. It is aligned with the perpendicular component of the field, if the probe axis is tilted nominally 35.3° above the measurement plane, using the connector rotation and sensor angle stated below.

The probe is fully RF shielded when operated with the matching signal cable (shielded) and allows measurement of audio magnetic fields in the close vicinity of RF emitting wireless devices according to [1] without additional shielding.

Handling of the item

The probe is manufactured from stainless steel. In order to maintain the performance and calibration of the probe, it must not be opened. The probe is designed for operation in air and shall not be exposed to humidity or liquids. For proper operation of the surface detection and emergency stop functions in a DASY system, the probe must be operated with the special probe cup provided (larger diameter).

Methods Applied and Interpretation of Parameters

- *Coordinate System:* The AM1D probe is mounted in the DASY system for operation with a HAC Test Arch phantom with AMCC Helmholtz calibration coil according to [2], with the tip pointing to "southwest" orientation.
- *Functional Test:* The functional test preceding calibration includes test of Noise level
RF immunity (1kHz AM modulated signal). The shield of the probe cable must be well connected.
Frequency response verification from 100 Hz to 5 kHz.
- *Connector Rotation:* The connector at the end of the probe does not carry any signals and is used for fixation to the DAE only. The probe is operated in the center of the AMCC Helmholtz coil using a 1 kHz magnetic field signal. Its angle is determined from the two minima at nominally +120° and -120° rotation, so the sensor in the tip of the probe is aligned to the vertical plane in z-direction, corresponding to the field maximum in the AMCC Helmholtz calibration coil.
- *Sensor Angle:* The sensor tilting in the vertical plane from the ideal vertical direction is determined from the two minima at nominally +120° and -120°. DASY system uses this angle to align the sensor for radial measurements to the x and y axis in the horizontal plane.
- *Sensitivity:* With the probe sensor aligned to the z-field in the AMCC, the output of the probe is compared to the magnetic field in the AMCC at 1 kHz. The field in the AMCC Helmholtz coil is given by the geometry and the current through the coil, which is monitored on the precision shunt resistor of the coil.

AM1D probe identification and configuration data

Item	AM1DV2 Audio Magnetic 1D Field Probe
Type No	SP AM1 001 AF
Serial No	1073

Overall length	296 mm
Tip diameter	6.0 mm (at the tip)
Sensor offset	3.0 mm (centre of sensor from tip)
Internal Amplifier	40 dB

Manufacturer / Origin	Schmid & Partner Engineering AG, Zürich, Switzerland
Manufacturing date	May-2008
Last calibration date	n/a

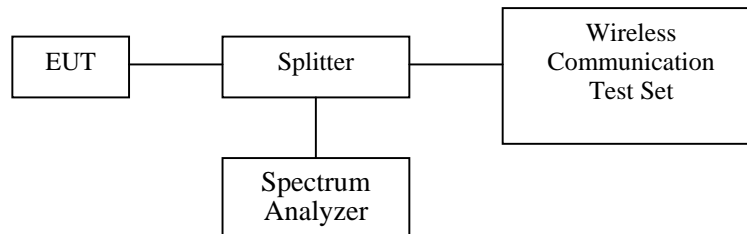
Calibration data

Connector rotation angle	(in DASY system)	125.5 °	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	-0.2 °	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	0.0661 V / (A/m)	+/- 2.2 % (k=2)

7 APPENDIX B – OUTPUT POWER MEASUREMENT

7.1 Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.



7.2 Test Equipment List and Details

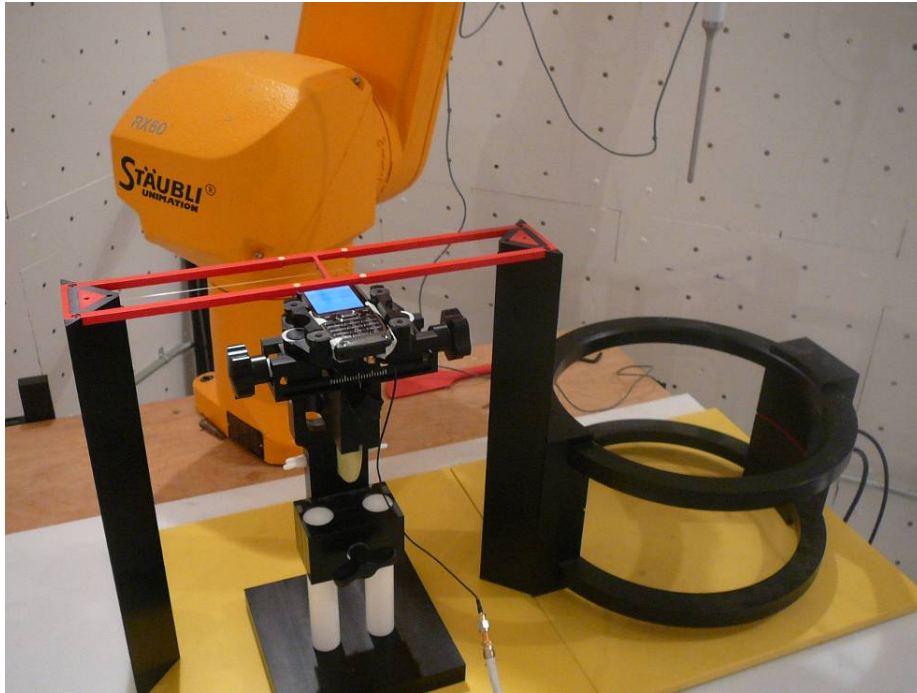
Manufacturer	Description	Model No.	Serial No.	Calibration Due Date
Agilent	Analyzer, Spectrum	E4440A	US45303156	2012-08-09
Rohde & Schwarz	Analyzer Communication	CMU200	103492	2013-06-29

7.3 Summary of Test Results

Mode	Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
GSM 850	LOW	824.2	32.91	1.95
	MIDDLE	836.6	32.97	1.98
	HIGH	848.8	32.94	1.97
PCS 1900	LOW	1850.2	29.39	0.87
	MIDDLE	1880.0	29.37	0.86
	HIGH	1909.8	29.26	0.84

8 APPENDIX C – TEST SETUP PHOTOS

8.1 T-Coil Test Setup Photo



9 APPENDIX G- EUT PHOTO

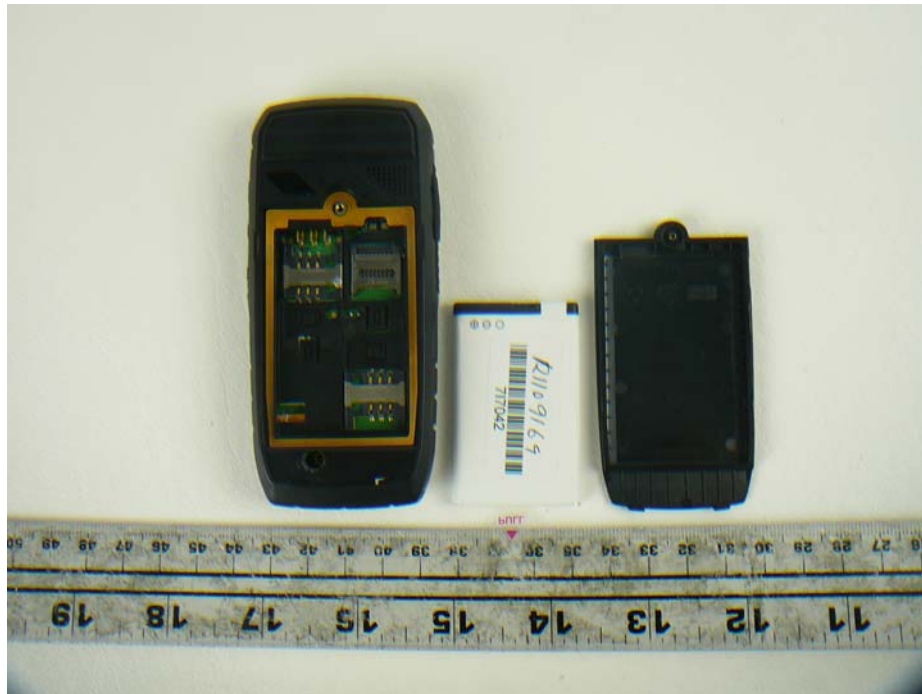
9.1 EUT – Front View



9.2 EUT – Rear View



9.3 EUT – Battery Compartment View



9.4 EUT – Accessory Charger



10 APPENDIX E - INFORMATIVE REFERENCES

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

[2] CFR47, Part20.19, Federal Communications Commission (FCC), Hearing Aid-Compatible Mobile Handsets

[3] FCC 08-68 A1, A2, A3, A4, A5, WT Docket 07-250, February 28, 2008.

[4] FCC OET KDB 285076, Equipment Authorization Guidance for Hearing Aid Compatibility, September 25, 2008.

--- END OF REPORT ---