



Variant HAC (T-Coil) TEST REPORT

Summary Result: T-Rating Category = T4

REPORT NO.: HC110705C18C-1

MODEL NO.: PH98100

FCC ID: NM8PH98100

RECEIVED: Aug. 23, 2011

TESTED: Oct. 17, 2011

ISSUED: Oct. 17, 2011

APPLICANT: HTC Corporation

ADDRESS: 23, Xinghua Rd., Taoyuan 330, Taiwan, R.O.C.

ISSUED BY: Bureau Veritas Consumer Products Services
(H.K.) Ltd., Taoyuan Branch

LAB ADDRESS: No. 47, 14th Ling, Chia Pau Tsuen, Lin Kou Dist.,
New Taipei City 244, Taiwan, R.O.C.

TEST LOCATION: No. 19, Hwa Ya 2nd Rd, Wen Hwa Tsuen, Kwei
Shan Hsiang, Taoyuan Hsien 333, Taiwan,
R.O.C.

This test report consists of 27 pages in total except Appendix. It may be duplicated completely for legal use with the approval of the applicant. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product certification, approval, or endorsement by any government agency. The test results in the report only apply to the tested sample.



TABLE OF CONTENTS

RELEASE CONTROL RECORD	3
1. CERTIFICATION	4
2. GENERAL INFORMATION	5
2.1 GENERAL DESCRIPTION OF THE EUT	5
2.2 DESCRIPTION OF SUPPORT UNITS	6
2.3 GENERAL DESCRIPTION OF APPLIED STANDARDS	6
3. SUMMARY OF THE TEST RESULTS	7
4. GENERAL INFORMATION OF THE DASY 5 SYSTEM	8
4.1 GENERAL INFORMATION OF TEST EQUIPMENT	8
4.2 TEST SYSTEM CONFIGURATION	12
4.3 TEST EQUIPMENT LIST	12
4.4 T-COIL MEASUREMENT UNCERTAINTY	13
5. SYSTEM VALIDATION & CALIBRATION	14
5.1 CABLING OF SYSTEM	14
5.2 INPUT CHANNEL CALIBRATION	14
5.3 PROBE CALIBRATION IN AMCC	15
5.4 REFERENCE INPUT LEVEL	16
5.4.1 SETTING OF THE AUDIO SIGNAL LEVEL	16
5.4.2 TARGET LEVEL FOR "AUDIO OUT" OF THE AMMI	17
5.4.3 MEASURED GAIN SETTING	17
5.5 REFERENCE INPUT OF AUDIO SIGNAL SPECTRUM	18
6. T-COIL TEST PROCEDURE	19
7. DESCRIPTION FOR EUT TESTING CONFIGURATION	22
8. T-COIL REQUIREMENTS AND CATEGORY	23
8.1 RF EMISSIONS	23
8.2 AXIAL FIELD INTENSITY	23
8.3 SIGNAL QUALITY	23
8.4 FREQUENCY RESPONSE	24
9. T-COIL TEST RESULT	25
9.1 SNR MEASUREMENT RESULT	25
9.2 FREQUENCY RESPONSE AT AXIAL MEASUREMENT POINT	26
10. INFORMATION ON THE TESTING LABORATORIES	27

APPENDIX A: TEST CONFIGURATIONS AND TEST DATA

APPENDIX B: SYSTEM CERTIFICATE & CALIBRATION



A D T

RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
Original release	N/A	Oct. 17, 2011



1. CERTIFICATION

PRODUCT : Smartphone
MODEL NO. : PH98100
BRAND : HTC
APPLICANT : HTC Corporation
TESTED : Oct. 17, 2011
STANDARDS : FCC 47 CFR Part 20.19
ANSI C63.19-2007
TEST ITEM: T-coil performance

This report is issued as a supplementary report of **HC110705C18-1** for a new inductive cover. This report shall be used combining with its original report. The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

PREPARED BY : Ivonne Wu , **DATE**: Oct. 17, 2011
Ivonne Wu / Senior Specialist

APPROVED BY : Gary Chang , **DATE**: Oct. 17, 2011
Gary Chang / Technical Manager

Note: Only the test mode of worst case according to the original report was performed for this addendum. Other testing data refers to original report.



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

EUT	Smartphone
MODEL NO.	PH98100
CLASSIFICATION	Portable device, Prototype
MODULATION TYPE	QPSK, OQPSK, HPSK
FREQUENCY RANGE	824.7MHz ~ 848.31MHz; 1851.25MHz ~ 1908.75MHz
T-COIL CATEGORY	T4
ANTENNA TYPE	Fixed internal antenna with -1dBi gain
I/O PORTS	Refer to user's manual
DATA CABLE	Refer to note as below
ACCESSORY DEVICES	Refer to note as below

Air Interfaces/Bands List						
Air Interface	Band	Type	C63.19 Tested	Simultaneous Transmissions	Reduced Power	VOIP
CDMA 1xRTT	850	Voice	Yes	EVDO+WLAN+BT LTE+WLAN+BT	N/A	N/A
	1900	Voice	Yes	EVDO+WLAN+BT LTE+WLAN+BT	N/A	N/A
CDMA 1xEVDO	850	Data	N/A	1xRTT+WLAN+BT	N/A	Yes
	1900	Data	N/A	1xRTT+WLAN+BT	N/A	Yes
LTE	750	Data	N/A	1xRTT+WLAN+BT	N/A	Yes
WLAN	2450, 5G	Data	N/A	1xRTT EVDO LTE	N/A	Yes
BT	2450	Data	N/A	1xRTT EVDO LTE	N/A	N/A

Note: The HAC rating was evaluated for voice mode only.

NOTE:

1. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.
2. This is a supplementary report of HC110705C18-1. This report shall be combined together with its original report.
3. This report is prepared for FCC class II permissive change. Difference compared with the original report is adding a new inductive cover (Part Number: BR C700). Therefore, only the testing was performed for this addendum according to original worst case mode.



2.2 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	CALIBRATED UNTIL
1	Universal Radio Communication Tester	R&S	CMU200	101095	Dec. 01, 2011

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	NA

NOTE: All power cords of the above support units are non shielded (1.8m).

2.3 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to the specifications of the manufacturer, this product must comply with the requirements of the following standards:

FCC 47 CFR Part 20.19

ANSI C63.19 - 2007

All test items have been performed and recorded as per the above standards.



3. SUMMARY OF THE TEST RESULTS

ANSI C63.19 (2007) T-coil result				
Mode	Test	Test Results	T-Rating	Verdit
CDMA850	Min. Field Strength (AMB1), dB A/m	-1.31	-	PASS
	Min. Signal Quality (ABM1/ABM2), dB	46.99	T4	PASS
	Frequency Response @ Axial position	PASS	-	PASS
CDMA1900	Min. Field Strength (AMB1), dB A/m	0.68	-	PASS
	Min. Signal Quality (ABM1/ABM2), dB	43.92	T4	PASS
	Frequency Response @ Axial position	PASS	-	PASS
Overall T-Rating :		T4		

4. GENERAL INFORMATION OF THE DASY 5 SYSTEM

4.1 GENERAL INFORMATION OF TEST EQUIPMENT

DASY5 (Software 5.2 Build 52.6) consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY 5 software defined. The DASY 5 software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC. This system consists of the following items:

AM1DV3 Audio Magnetic Field 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).

Specification:

Frequency range	0.1 ~ 20 kHz (RF sensitivity <-100dB, fully RF shielded)
Sensitivity	<-50dB A/m @ 1 kHz
Pre-amplifier	40 dB, symmetric
Dimensions	Tip diameter/ length: 6/ 290 mm, sensor according to ANSI-C63.19



DATA ACQUISITION ELECTRONICS (DAE)

CONSTRUCTION

The data acquisition electronics (DAE 4) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplex, 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. The mechanical probe is mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE3,4 box is 200M Ω m; the inputs are symmetrical and floating. Common mode rejection is above 80dB.



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.

Specification:

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

Connection:

Front connectors
 Audio Out - audio signal to the base station simulator
 Coil Out - test and calibration signal to the AMCC
 Coil In - monitor signal from the AMCC BNO connector
 Probe In - probe signal

Dimensions

482 x 65 x 270 mm

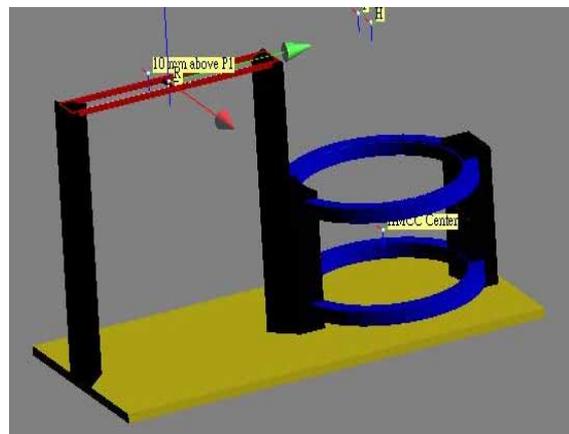
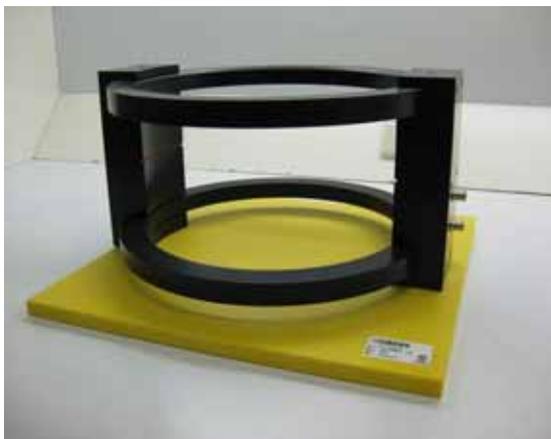


AMCC

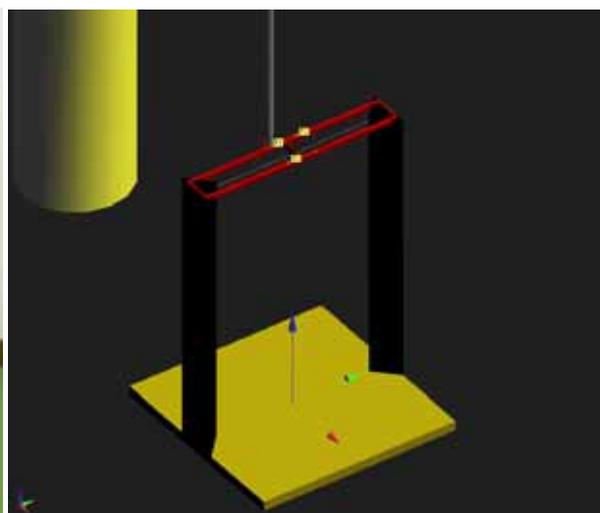
The Audio Magnetic Calibration coil is a Helmholtz Coil designed according to ANSI C63.19-2007 section D.9, for calibration of the AM1D probe. The two horizontal coils generate a homogeneous magnetic field in the z direction. The DC input resistance is adjusted to approximately 50 Ohm by a series resistor, and a shunt resistor of 10 Ohm allows monitoring the current with a scale of 1:10.

Specification:

Coil In	typically 50 Ohm
Coil Monitor	10Ohm \pm 1%(100mV corresponding to 1 A/m)
Dimensions	370 x 370 x 196 mm



HAC ARCH



DIMENSIONS 370 x 370 x 370mm



A D T

DEVICE HOLDER



CONSTRUCTION Supports accurate and reliable positioning of any phone effect on near field $\pm 0.5\text{dB}$

4.2 TEST SYSTEM CONFIGURATION



Figure 4.2: T-Coil setup with HAC Test Arch and AMCC

4.3 TEST EQUIPMENT LIST

ITEM	NAME	BRAND	TYPE	SERIES NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
1	Audio Band Magnetic Probe	SPEAG	AM1DV3	3060	Jan. 18, 2011	Jan. 17, 2012
2	DAE	SPEAG	DAE4	861	Aug. 29, 2011	Aug. 28, 2012
3	Audio Band Magnetic Measuring Instrument	SPEAG	AMMI	1075	NA	NA
4	Helmholtz Coil	SPEAG	AMCC	1076	NA	NA

NOTE1: All test equipment has been calibrated by the SPEAG. Please reference" APPENDIX B "for the calibration report.



4.4 T-COIL MEASUREMENT UNCERTAINTY

HAC UNCERTAINTY BUDGET ACCORDING TO ANSI C63.19							
ERROR DESCRIPTION	UNCERTAINTY VALUE	PROBABILITY DISTRIBUTION	DIV.	(C _i) ABM1	(C _i) ABM2	STD. UNC. AMB1	STD. UNC. AMB2
PROBE SENSITIVITY							
Reference level	±3.0%	Normal	1	1	1	±3.0%	±3.0%
AMCC geometry	±0.4%	Rectangular	√3	1	1	±0.2%	±0.2%
AMCC current	±1.0%	Rectangular	√3	1	1	±0.6%	±0.6%
Probe positioning during calibration	±0.1%	Rectangular	√3	1	1	±0.1%	±0.1%
Noise contribution	±0.7%	Rectangular	√3	0.0143	1	±0.0%	±0.4%
Frequency slope	±5.9%	Rectangular	√3	0.1	1	±0.3%	±3.5%
PROBE SYSTEM							
Repeatability / Drift	±1.0%	Rectangular	√3	1	1	±0.6%	±0.6%
Linearity / Dynamic range	±0.6%	Rectangular	√3	1	1	±0.4%	±0.4%
Acoustic noise	±1.0%	Rectangular	√3	0.1	1	±0.1%	±0.6%
Probe angle	±2.3%	Rectangular	√3	1	1	±1.4%	±1.4%
Spectral processing	±0.9%	Rectangular	√3	1	1	±0.5%	±0.5%
Integration time	±0.6%	Normal	1	1	5	±0.6%	±3.0%
Field distribution	±0.2%	Rectangular	√3	1	1	±0.1%	±0.1%
TEST SIGNAL							
Reference signal spectral response	±0.6%	Rectangular	√3	0	1	±0.0%	±0.4%
POSITIONING							
Probe positioning	±1.9%	Rectangular	√3	1	1	±1.1%	±1.1%
Phantom thickness	±0.9%	Rectangular	√3	1	1	±0.5%	±0.5%
DUT positioning	±1.9%	Rectangular	√3	1	1	±1.1%	±1.1%
EXTERNAL CONTRIBUTIONS							
RF interference	±0.0%	Rectangular	√3	1	0.3	±0.0%	±0.0%
Test signal variation	±2.0%	Rectangular	√3	1	1	±1.2%	±1.2%
Combined Standard Uncertainty (ABM):						±4.1%	±6.1%
Extended Standard Uncertainty (k=2) [%]:						±8.1%	±12.3%

The uncertainty budget for HAC Audio Band Magnetic Field (AMB) assessment according to ANSI C63.19-2007. The budget is valid for the DASY system and represents a worst- case analysis. For specific tests and configurations, the uncertainty could be smaller.

5. SYSTEM VALIDATION & CALIBRATION

At the beginning of the HAC T-coil measurement, a 3-phase calibration was performed per Speag instruction to ensure accurate measurement of the voltages and ABM field. Reference input level was also validated and calibrated per C63.19.

5.1 CABLING OF SYSTEM

The principal cabling of the T-Coil setup is shown in Figure 6.1 All cables provided with the basic setup have a length of approximately 5 m.

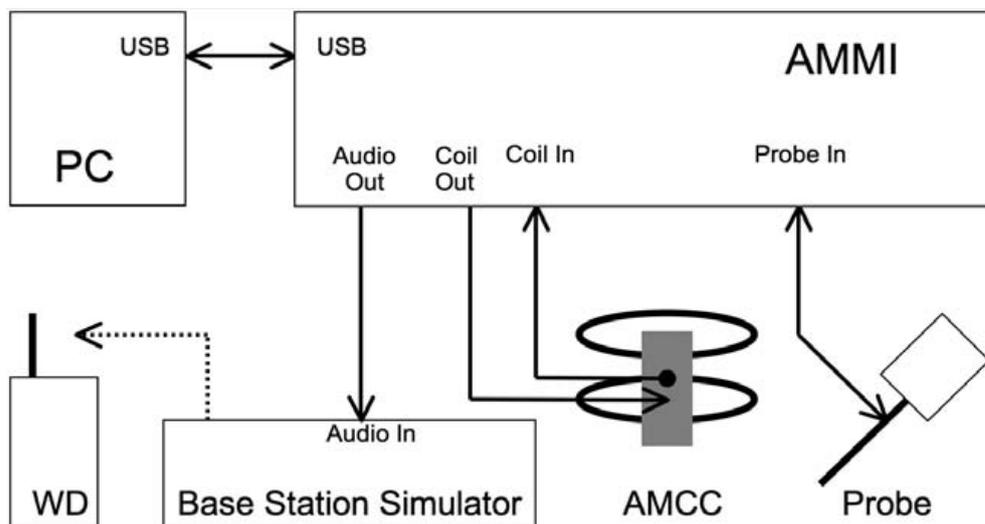


Figure 5.1: T-Coil setup cabling

5.2 INPUT CHANNEL CALIBRATION

Phase 1: The AMMI audio output was switched off, and a 200 mV_{pp} symmetric rectangular signal of 1 kHz was generated and internally connected directly to both channels of the sampling unit (coil in, probe in).

Phase 2: The AMMI audio output was off, and a 20 mV_{pp} symmetric 100 Hz signal was internally connected.

The signals during phases 1 and 2 were 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 were both calibrated for absolute measurements of voltages. The resulting factors were displayed above the multimeter window.

After phases 1 and 2, the input channels were calibrated to measure exact voltages.

5.3 PROBE CALIBRATION IN AMCC

Phase 3: Probe Calibration in AMCC

The probe sensitivity at **1 kHz is 0.00731303V / (A/m)** was calibrated by AMCC coil for verification of setup performance. The evaluated probe sensitivity was able to be compared to the calibration of the AM1D probe. The frequency response and sensitivity was shown in appendix A1. The probe signal is represented after application of an ideal integrator. The green curve represents the current through the AMCC, the blue curve the integrated probe signal. The difference between the two curves is equivalent to the frequency response of the probe system and shows the characteristics. The probe/system complies with the frequency response and linearity requirements in C63.19 according to the Speag's calibrated report as shown in appendix C1

- (1)The frequency response has been tested within +/- 0.5 dB of ideal differentiator from 100 Hz to 10 kHz.
- (2)The linearity has also been tested within 0.1dB from 5 dB below limitation to 16 dB above noise level. The AMCC coil is qualified according to certificate report that shown in appendix B.



5.4 REFERENCE INPUT LEVEL

An Input Level is measured to verify that it is within +/-0.2 dB from the Reference Input Level in section 6.3.2.1 of ANSI C63.19-2007.

5.4.1 SETTING OF THE AUDIO SIGNAL LEVEL

According to ANSI C63.19:2007 section 6.3.2.1, the normal speech input level for HAC T-coil tests shall be set to -16 dBm0 for GSM and UMTS (WCDMA), and to -18 dBm0 for CDMA. 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 B85. Establish a call from the CMU200 to a wireless device. Select CMU200 Network Bitstream "Decoder Cal" to have a 1kHz signal with a level of 3.14 dBm0 at the speech 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 -16dBm0 & -18dBm0:

$$3.14 \text{ dBm0} = X \text{ dBV}$$

$$-16 \text{ dBm0} = L1 \text{ dBV}$$

$$-18 \text{ dBm0} = L2 \text{ dBV}$$

Determine the 1kHz input level to generate the desired signal level. Select CMU200 Network Bitstream "Codec Cal" to loop the input via the codec to the output. Run the measurement job (AMMI 1kHz signal with gain 10 inserted) and read the voltage level at the multimeter display "Coil signal". Calculate the required gain setting for the above levels:

$$\text{Gain } 10 = G \text{ dBV}$$

$$\text{Difference for } -16 \text{ dBm0} = L1 - (G) = D1 \text{ dB}$$

$$\text{Difference for } -18 \text{ dBm0} = L2 - (G) = D2 \text{ dB}$$

$$\text{Gain factor for } -16 \text{ dBm0} = 10^{((D1) / 20)} = F1$$

$$\text{Gain factor for } -18 \text{ dBm0} = 10^{((D2) / 20)} = F2$$

$$\text{Resulting Gain for } -16 \text{ dBm0} = 10 \times F1 = R1$$

$$\text{Resulting Gain for } -18 \text{ dBm0} = 10 \times F2 = R2$$

5.4.2 TARGET LEVEL FOR “AUDIO OUT” OF THE AMMI

(CMU200 Audio Codec Calibration)

Measured data is shown in Table 5.4.1. This target level takes into account the difference between AMMI’s and CMU’s reference levels.

Table 5.4.1: Measured Input Level

CMU voltage level(dBV)	AMMI 1kHz signal with gain 10 inserted(dBV)
-2.51	-19.82

5.4.3 MEASURED GAIN SETTING

The predefined signal types have the following differences / factors compared to the 1kHz sine signal:

Table 5.4.2: Measured Gain Setting

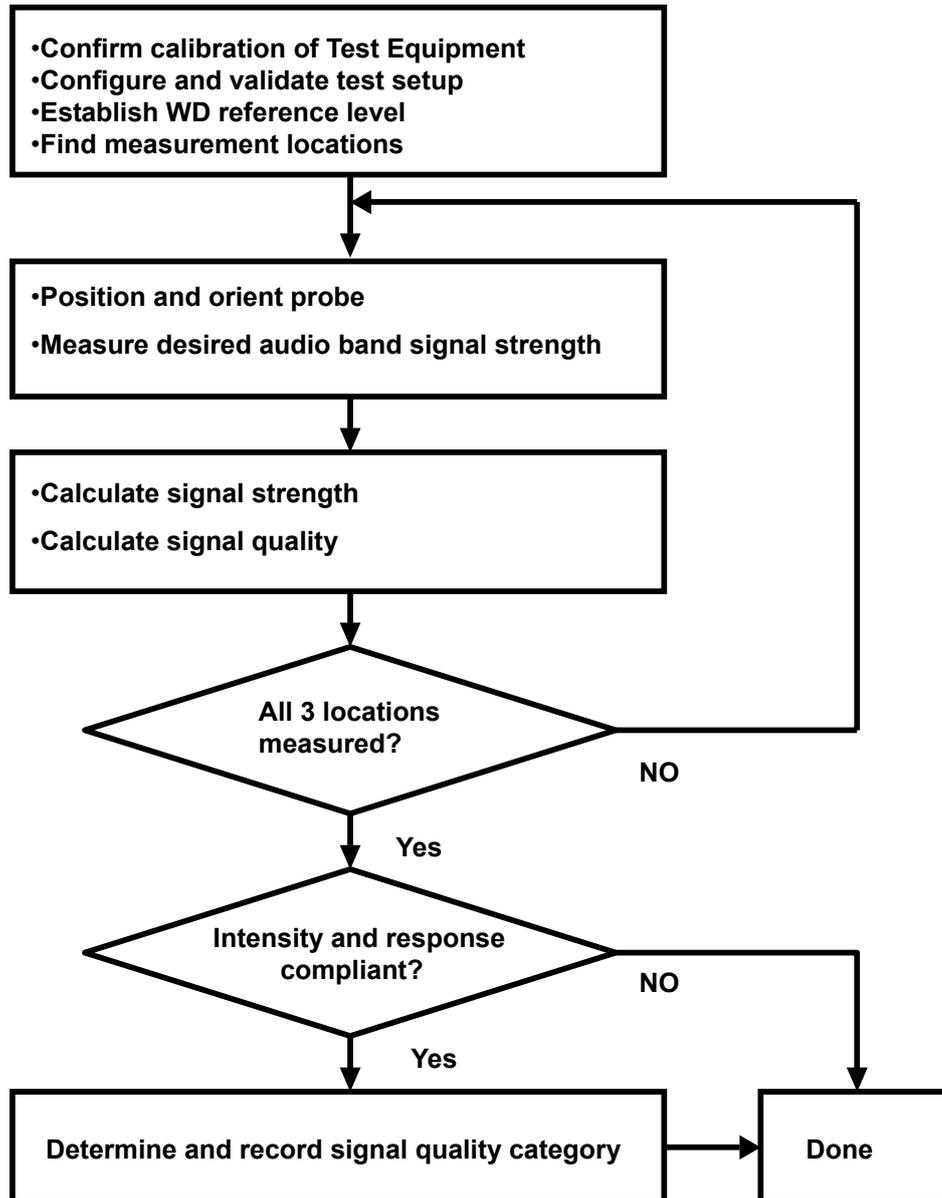
Audio Signal Level	Signal Type Duration	Peak to RMS (dB)	RMS(dB)	Gain factor	Gain Setting
-18dBm0	1KHz	16.2	-12.7	4.33	27.86
-18dBm0	300 to 3KHz	21.6	-18.6	8.48	54.56

5.5 REFERENCE INPUT OF AUDIO SIGNAL SPECTRUM

With the reference job "use as reference" in the beginning of a procedure, measure the spectrum of the current when applied to the AMCC, i.e. the input magnetic field spectrum, as shown in the **appendix A2**. For this, the delay of the window shall be set to a multiple of the signal period and at least 2s. From the measurement on the device, using the same signal, the postprocessor deducts the input spectrum, so the result represents the net DUT response.

6. T-COIL TEST PROCEDURE

The device was positioned and setup according to ANSI C63.19-2007. The following shows the T-Coil Signal measurement flowchart:





The following steps were a typical test scan for the wireless communications device:

1. Geometry and signal check: system probe alignment, proper operation of the field probe, probe measurement system, other instrumentation, and the positioning system was confirmed.
A surface calibration was performed before each setup change to ensure repeatable spacing and proper maintenance of the measurement plane using the test Arch.
2. Set the reference drive level of signal voice defined in C63.19 per 6.3.2.1, as shown in the **appendix A2** of this report
3. The ambient and test system background noise (dB A/m) was measured as well as ABM2 over the full measurement. The maximum noise level must be at least 10dB below the limit of C63.19 per 7.3.2.
For the three probe positions, noise spectrum plots for the highest ambient noise are given in **appendix A3**.
4. The DUT was positioned in its intended test position, acoustic output point of the device perpendicular to the field probe.
5. The DUT operation for maximum rated RF output power was configured and connected by using of coaxial cable connection to the base station simulator at the test channel and other normal operating parameters as intended for the test. The battery was ensured to be fully charged before each test. The center sub-grid was centered over the center of the acoustic output (also audio band magnetic output, if applicable). The DUT audio output was positioned tangent (as physically possible) to the measurement plane.
6. The DUT's RF emission field was eliminated from T-coil results by using a well RF-shielding of the probe, AM1D, and by using of coaxial cable connection to a Base Station Simulator. One test channel was pre-measurement to avoid this possibility.
7. Determined the optimal measurement locations for the DUT by following the three steps, coarse resolution scan, fine resolution scans, and point measurement, as described in C63.19 per 6.3.4.4. At each measurement locations, samples in the measurement window duration were evaluated to get ABM1 and the signal spectrum. The noise measurement was performed after the scan with the signal, the same happened, just with the voice signal switched off. The ABM2 was calculated from this second scan.
 - (1) Coarse resolution scans (1 KHz signal at 50 x 50 mm grid area with 10 mm spacing). Only ABM1 was measured in order to find the location of T-Coil source.
 - (2) Fine resolution scans (1 KHz signal at 10 x 10 mm grid area with 2 mm spacing). The positioned appropriately based on optimal AMB1 of coarse resolution scan. Both ABM1 and ABM2 were measured in order to find the location of the SNR point.
 - (3) Point measurement (1 KHz signal) for ABM1 and ABM2 in axial, radial transverse and radial longitudinal. The positioned appropriately based on optimal SNR of fine resolution scan. The SNR was calculated for axial, radial transverse and radial longitudinal orientation.

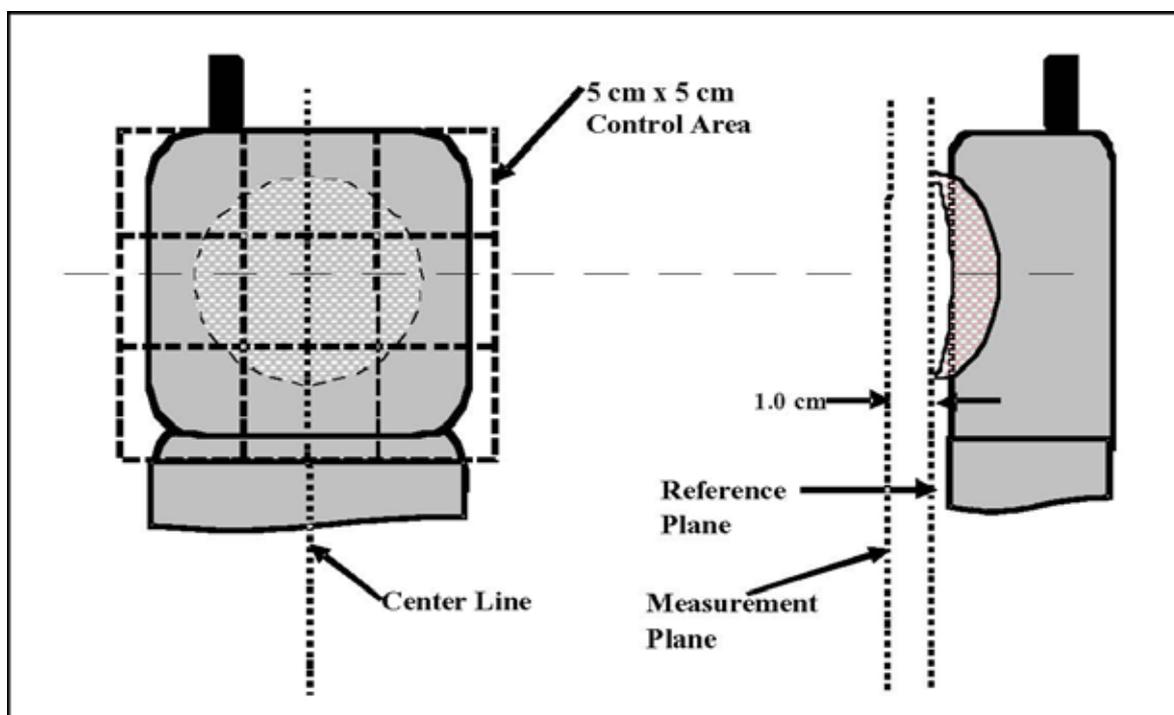
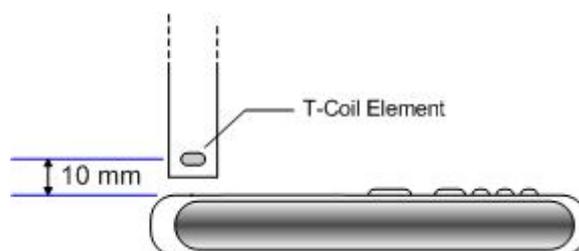


- (4) Point measurement (300Hz to 3 KHz signal) for frequency response in axial. The positioned appropriately based on optimal SNR of fine resolution axial scan.
8. All results resulting from a measurement point in a T-Coil job were calculated from the signal samples during this window interval. ABM values were averaged over the sequence of these samples.
9. At an optimal point measurement, the SNR(ABM1/ABM2) was calculated for axial, radial transverse and radial longitudinal orientation, and the frequency response was measured in axial axis.
10. Corrected for the frequency response after the DUT measurement since the DASY5 system had known the spectrum of the input signal by using a reference job, as shown in the **appendix B2** of this report.
11. In SEMCAD post-processing, the spectral points are in addition scaled with the high-pass (half-band) and the A-weighting, bandwidth compensated factor (BWC) and those results are final as shown in this report.
12. Classified the signal quality based on the T-Coil Signal Quality Categories.

7. DESCRIPTION FOR EUT TESTING CONFIGURATION

The phone was tested in normal configurations for the ear use. The DASY5 measurement system specified in section 3.1 was utilized within the intended operations as set by the SPEAG™ setup. The Test Arch provided by SPEAG is used to position the DUT. All tests are done via conducted setup with CMU 200.

The distance is established by positioning the device beneath the test arch phantom so that it is touching the frame. The location and thickness of the arch, and the location/orientation of the coil within the probe housing, are precisely known values in the DASY software. The height of the measurement plane is further fine-tuned by performing a Surface Detection job at the beginning of each test. The end result is that the probe sensor is very precisely located 10mm above the device reference plane.



8. T-COIL REQUIREMENTS AND CATEGORY

8.1 RF EMISSIONS

EUT has to fulfill RF emission requirements at the axial measurement location.

8.2 AXIAL FIELD INTENSITY

The minimum limits of ABM1 field intensity shall be ≥ -18 dB (A/m) at 1 kHz, in a 1/3 octave band filter for all orientations.

8.3 SIGNAL QUALITY

Table 9.3 provides the signal quality requirement for the intended T-Coil signal from a Wireless Device. The worst Signal Quality of the axial and radial components of the magnetic field was used to determine the T-Coil category

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

8.4 FREQUENCY RESPONSE

The frequency response of the axial component must follow the frequency curve specified in ANSI C63.19-2007 section 7.3.3, over the frequency range 300-3000 Hz.

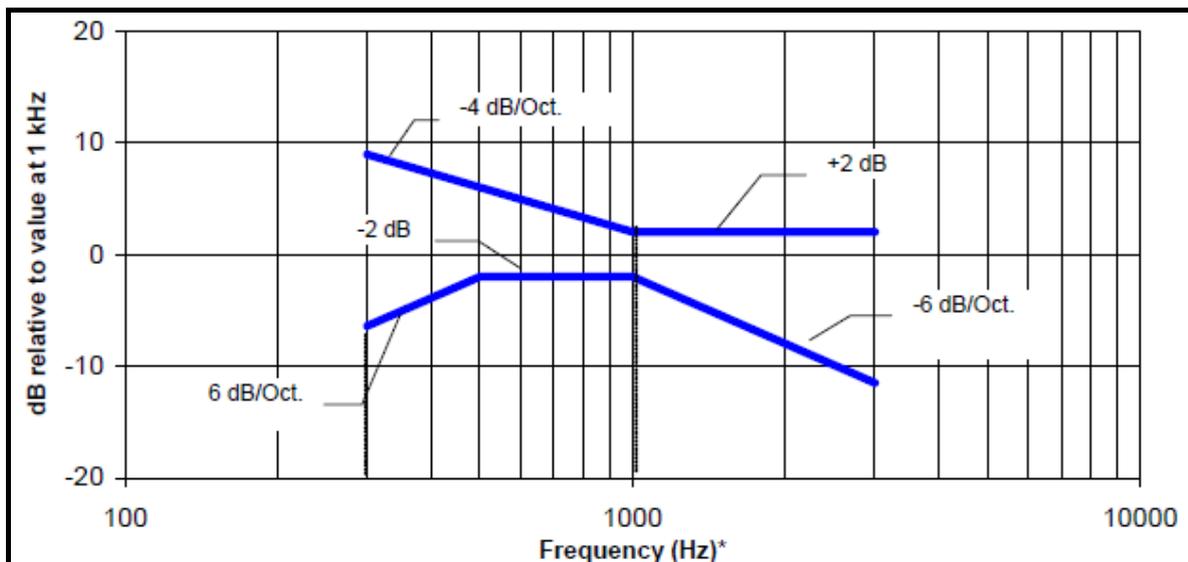


Figure 8.4a Magnetic field frequency response for WDs with a field ≤ -15 dB (A/m) at 1 kHz

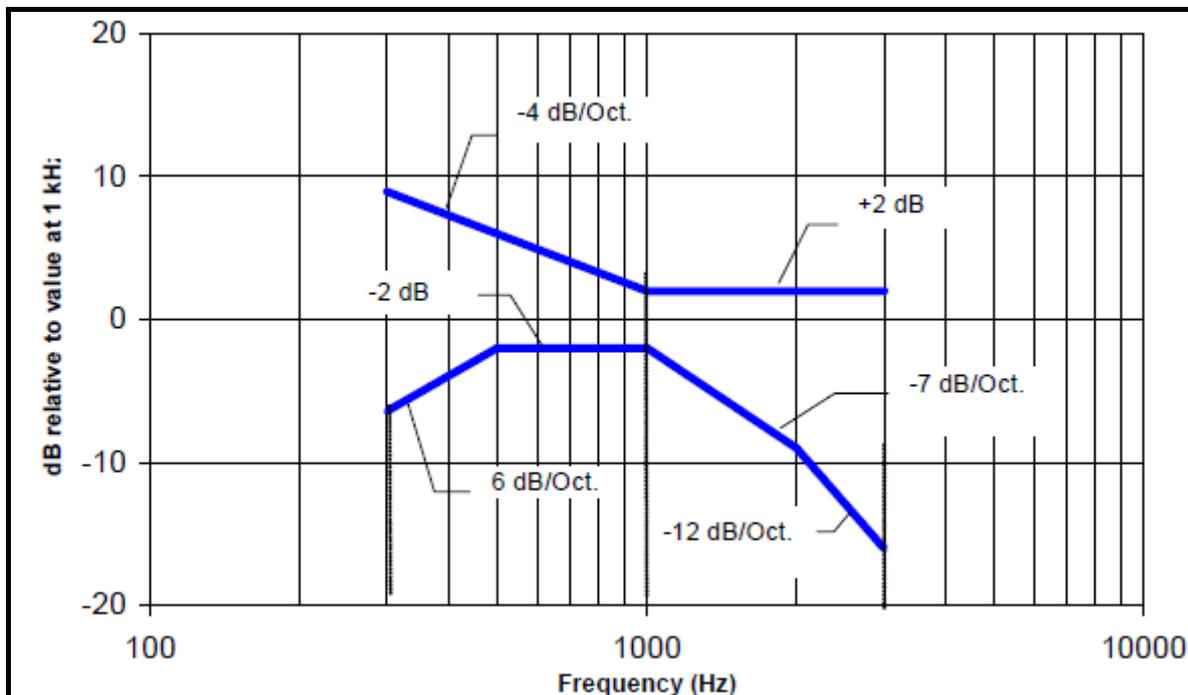


Figure 8.4b Magnetic field frequency response for WDs with a field that exceeds -15 dB(A/m) at 1 kHz

9. T-COIL TEST RESULT

9.1 SNR MEASUREMENT RESULT

Band	Mode	Ch.	Probe Position	Coordinates (mm)	Ambient Noise (dB A/m)	ABM2 (dB A/m)	ABM1 (dB A/m)	SNR (dB)	T Rating
CDMA2000 BC0	RC1+SO3	777	Axial (Z)	2.2,10.5	-51.96	-39.95	11.45	51.40	T4
			Radial 1 (X)	-13.8,15.5	-54.69	-48.30	-1.31	46.99	T4
			Radial 2 (Y)	1.2,6.5	-54.77	-40.65	8.57	49.22	T4
CDMA2000 BC1	RC1+SO3	25	Axial (Z)	0.2,12.3	-54.69	-40.01	9.88	49.89	T4
			Radial 1 (X)	-7.8,11.3	-54.41	-43.24	0.68	43.92	T4
			Radial 2 (Y)	1.2,5.3	-54.64	-39.37	9.73	49.10	T4

Table 9.1: Test Result for Various Positions

Note:

1. Only the testing was performed for this addendum according to original worst case mode.



Note:

- Minimum Limit: $ABM1 \geq -18$ dB A/m
- Signal Quality = $ABM1/ABM2$
- Bold Number = worst case at each frequency band
- Data plots are showed in **appendix A**

9.2 FREQUENCY RESPONSE AT AXIAL MEASUREMENT POINT

Cell Phone Mode	Verdict
CDMA2000 BC0	Pass
CDMA2000 BC1	Pass

Note: Please see **appendix A** for the frequency response test raw data.



10. INFORMATION ON THE TESTING LABORATORIES

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

Copies of accreditation and authorization certificates of our laboratories obtained from approval agencies can be downloaded from our web site:

www.adt.com.tw/index.5/phtml. If you have any comments, please feel free to contact us at the following:

Linko EMC/RF Lab:

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF Lab:

Tel: 886-3-5935343

Fax: 886-3-5935342

Hwa Ya EMC/RF/Safety/Telecom Lab:

Tel: 886-3-3183232

Fax: 886-3-3185050

Web Site: www.adt.com.tw

The address and road map of all our labs can be found in our web site also.

---END---

P01 T-Coil_CDMA2000 BC0_RC1+SO3_Ch777_Sample5_Battery1_Axial (Z)

DUT: 110823C21

Communication System: CDMA2000; Frequency: 848.31 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.4 °C

DASY5 Configuration:

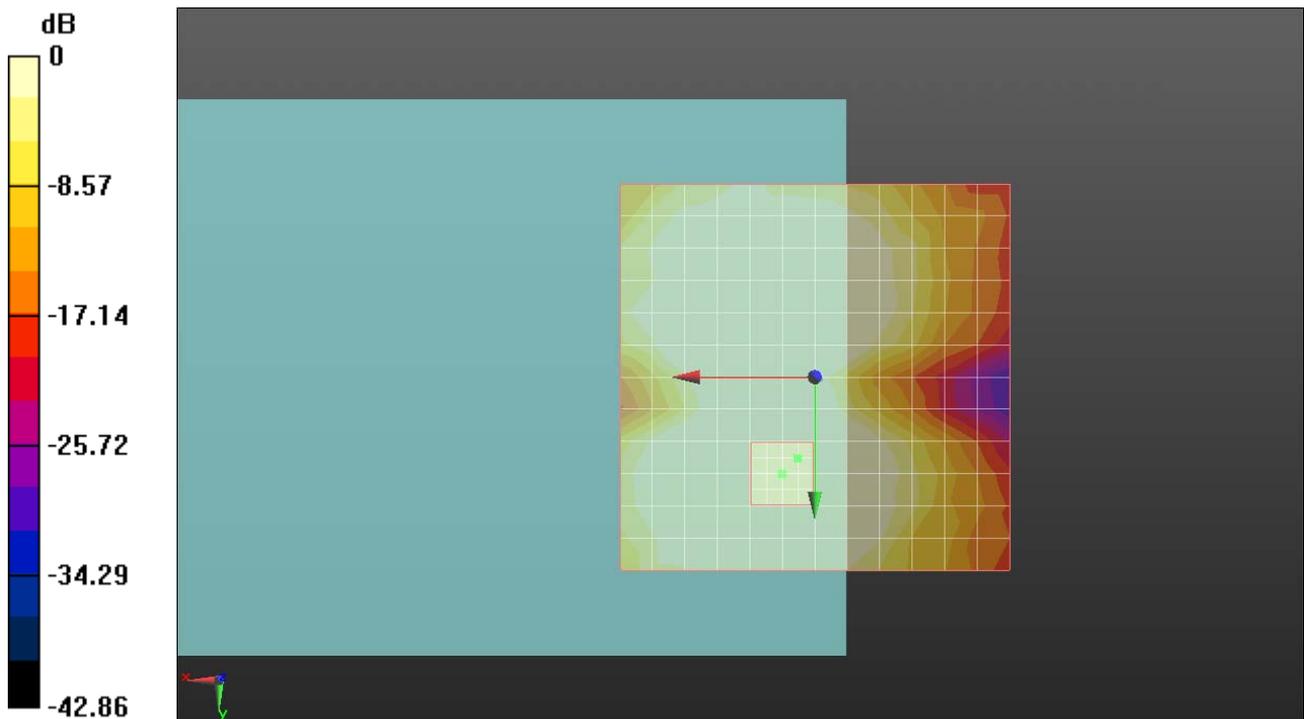
- Probe: AM1DV3 - 3060; ; Calibrated: 2011/1/18
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn861; Calibrated: 2011/8/29
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Scans/z (axial) fine 2mm 8 x 8/ABM [HAC-2007] SNR(x,y,z) (5x5x1):

ABM1/ABM2 = 51.40 dB

ABM1 comp = 11.45 dB A/m

Location: 2.2, 10.5, 3.7 mm



0 dB = 1.000A/m

Scans/z (axial) wideband at best S/N/ABM [HAC-2007] Freq Resp(x,y,z,f)

Loc: 2.2, 10.5, 3.7 mm Diff: 0.84dB



P01 T-Coil_CDMA2000 BC0_RC1+SO3_Ch777_Sample5_Battery1_Radial 1 (X)

DUT: 110823C21

Communication System: CDMA2000; Frequency: 848.31 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.4 °C

DASY5 Configuration:

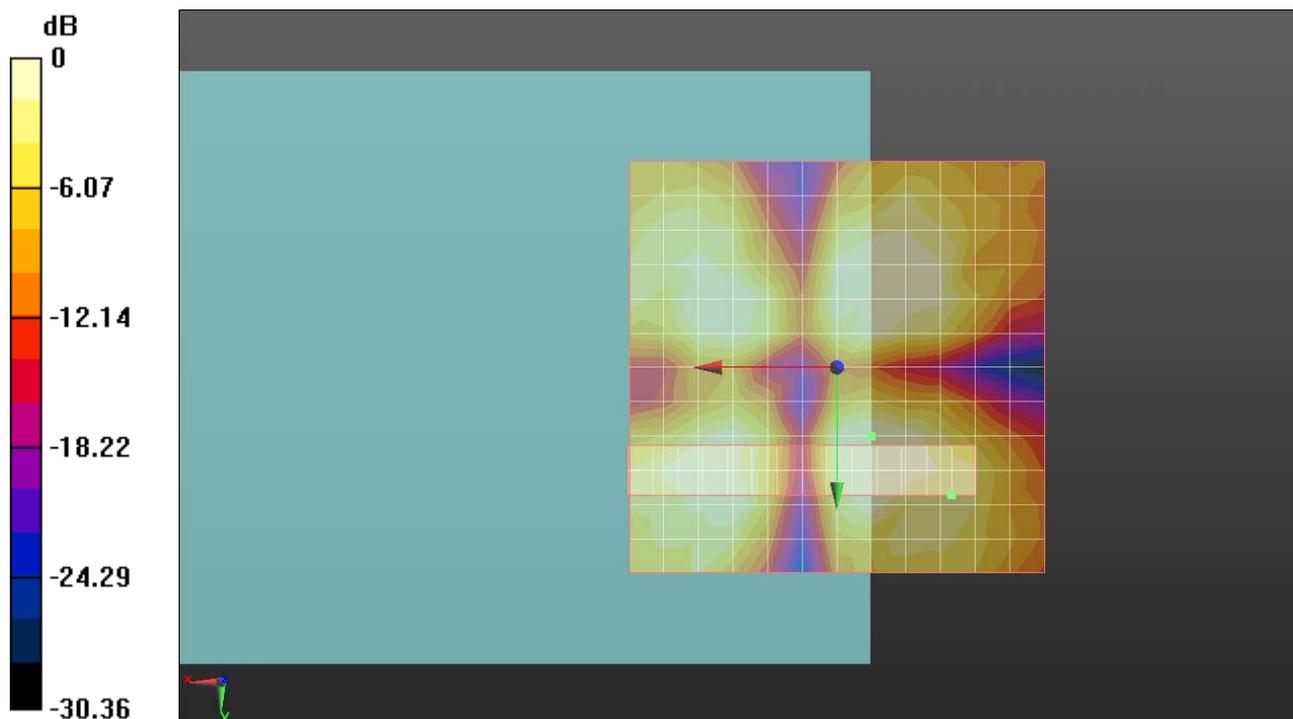
- Probe: AM1DV3 - 3060; ; Calibrated: 2011/1/18
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn861; Calibrated: 2011/8/29
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Scans/x (longitudinal) fine 3mm 42 x 6/ABM [HAC-2007] SNR(x,y,z) (15x3x1):

ABM1/ABM2 = 46.99 dB

ABM1 comp = -1.31 dB A/m

Location: -13.8, 15.5, 3.7 mm



0 dB = 1.000A/m

P01 T-Coil_CDMA2000 BC0_RC1+SO3_Ch777_Sample5_Battery1_Radial 2 (Y)

DUT: 110823C21

Communication System: CDMA2000; Frequency: 848.31 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.4 °C

DASY5 Configuration:

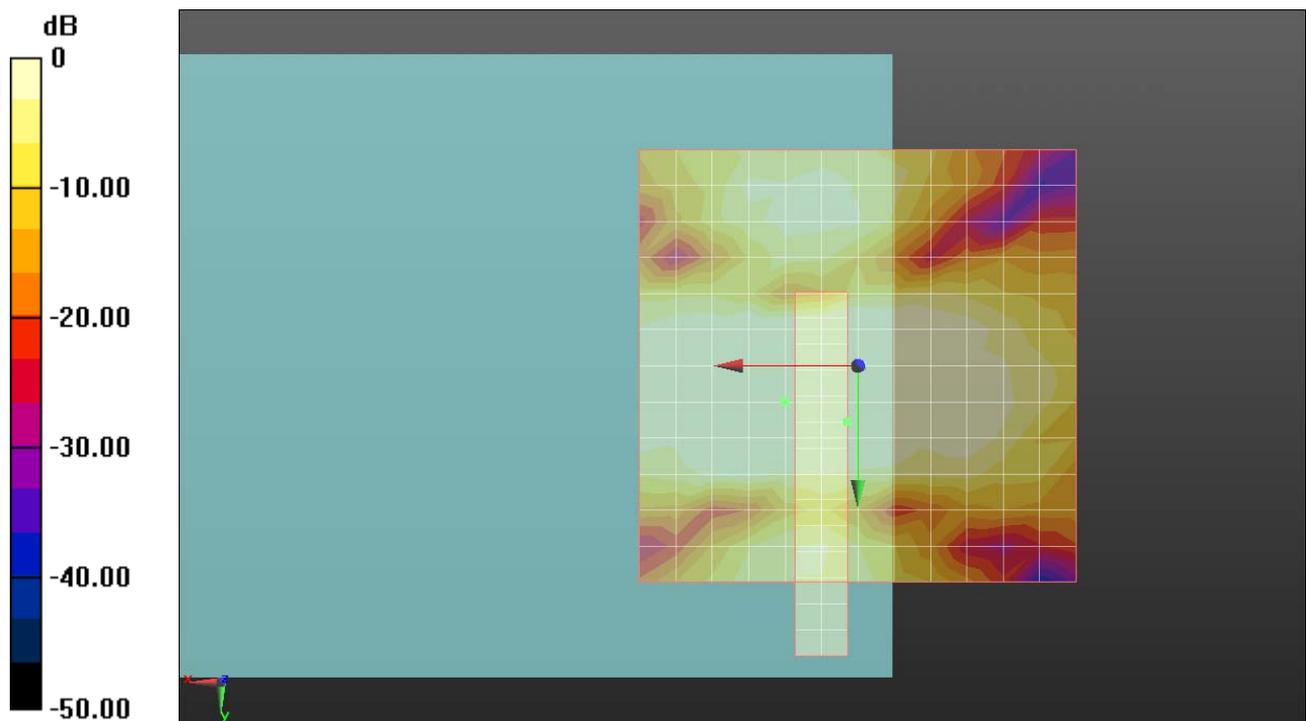
- Probe: AM1DV3 - 3060; ; Calibrated: 2011/1/18
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn861; Calibrated: 2011/8/29
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Scans/y (transversal) fine 3mm 6 x 42/ABM [HAC-2007] SNR(x,y,z) (3x15x1):

ABM1/ABM2 = 49.22 dB

ABM1 comp = 8.57 dB A/m

Location: 1.2, 6.5, 3.7 mm



0 dB = 1.000A/m

P02 T-Coil_CDMA2000 BC1_RC1+SO3_Ch25_Sample5_Battery1_Axial (Z)

DUT: 110823C21

Communication System: CDMA2000; Frequency: 1851.25 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.5 °C

DASY5 Configuration:

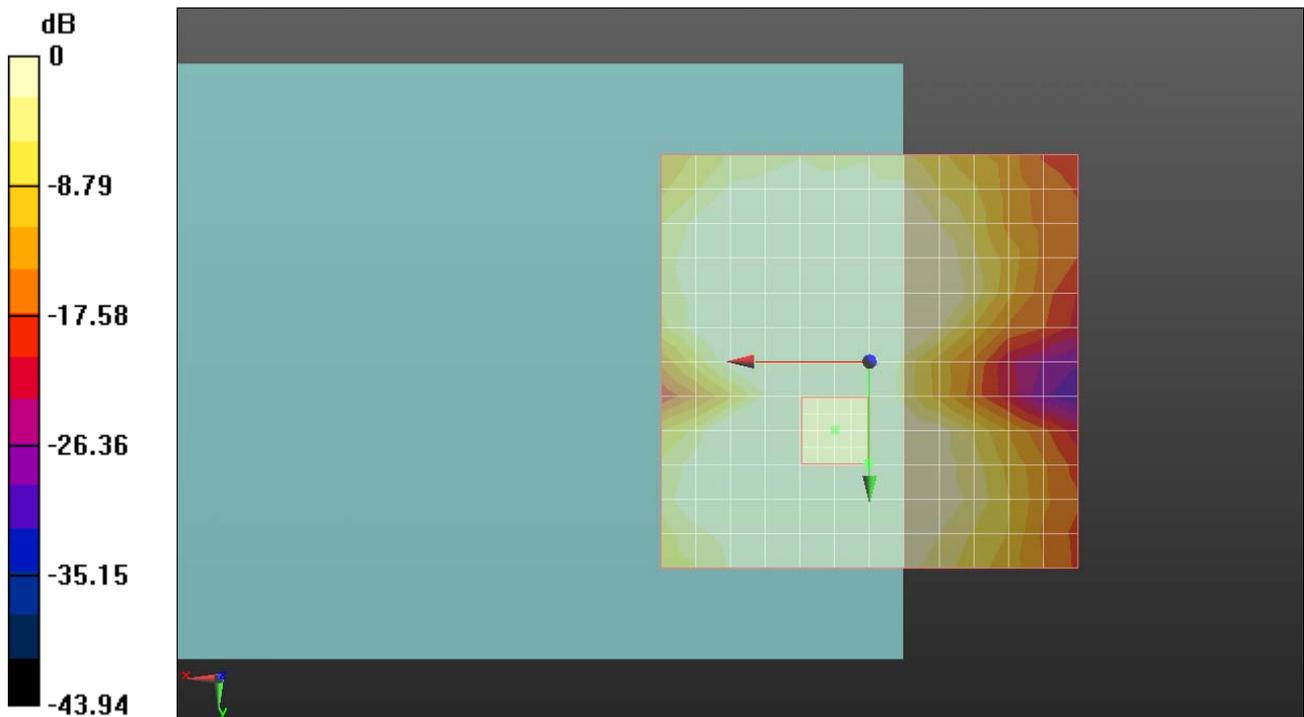
- Probe: AM1DV3 - 3060; ; Calibrated: 2011/1/18
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn861; Calibrated: 2011/8/29
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Scans/z (axial) fine 2mm 8 x 8/ABM [HAC-2007] SNR(x,y,z) (5x5x1):

ABM1/ABM2 = 49.89 dB

ABM1 comp = 9.88 dB A/m

Location: 0.2, 12.3, 3.7 mm



0 dB = 1.000A/m

Scans/z (axial) wideband at best S/N/ABM [HAC-2007] Freq Resp(x,y,z,f)

Loc: 0.2, 12.3, 3.7 mm Diff: 1.49dB



P02 T-Coil_CDMA2000 BC1_RC1+SO3_Ch25_Sample5_Battery1_Radial 1 (X)

DUT: 110823C21

Communication System: CDMA2000; Frequency: 1851.25 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.5 °C

DASY5 Configuration:

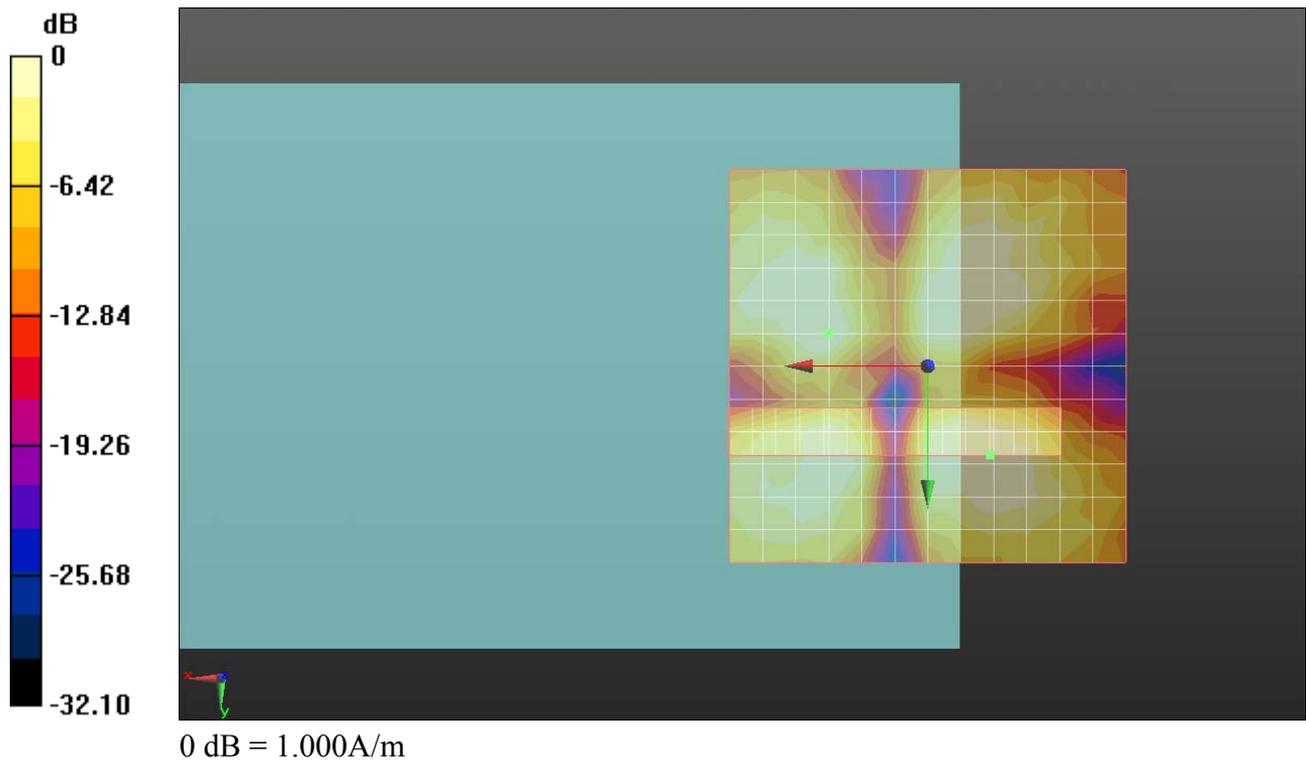
- Probe: AM1DV3 - 3060; ; Calibrated: 2011/1/18
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn861; Calibrated: 2011/8/29
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Scans/x (longitudinal) fine 3mm 42 x 6/ABM [HAC-2007] SNR(x,y,z) (15x3x1):

ABM1/ABM2 = 43.92 dB

ABM1 comp = 0.68 dB A/m

Location: -7.8, 11.3, 3.7 mm



P02 T-Coil_CDMA2000 BC1_RC1+SO3_Ch25_Sample5_Battery1_Radial 2 (Y)

DUT: 110823C21

Communication System: CDMA2000; Frequency: 1851.25 MHz; Duty Cycle: 1:1

Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Ambient Temperature : 22.5 °C

DASY5 Configuration:

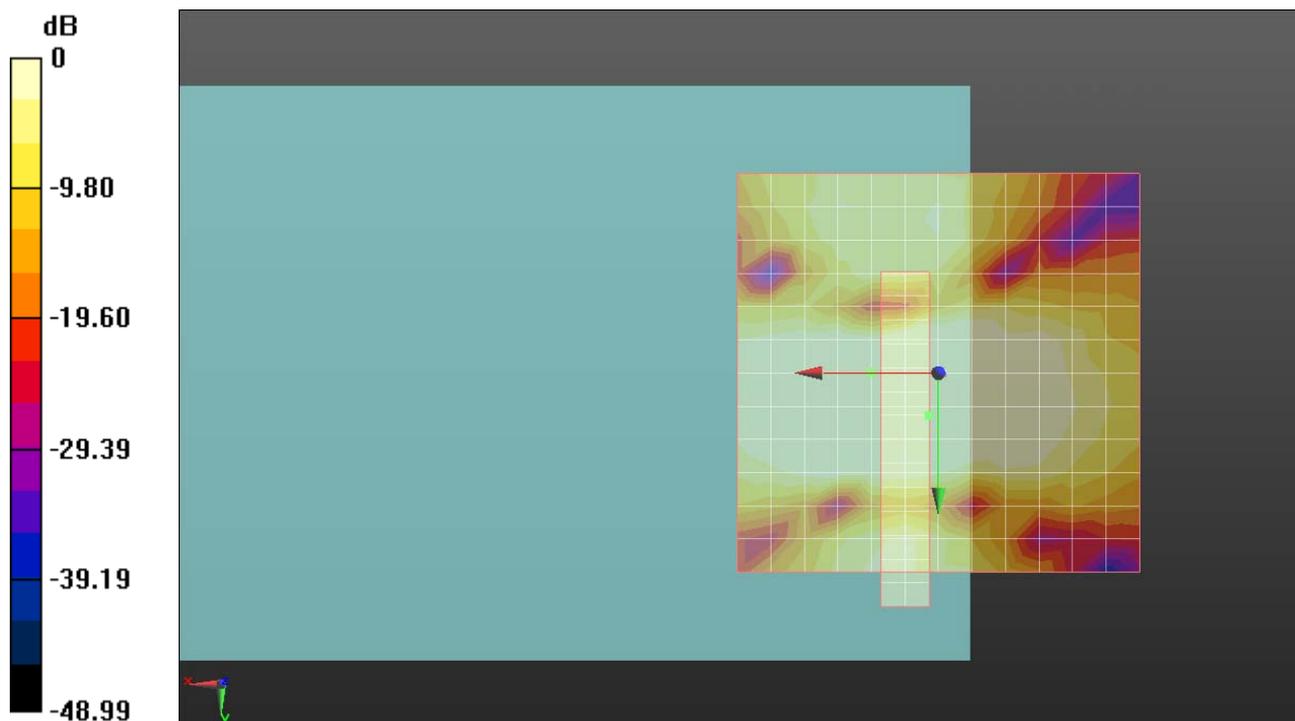
- Probe: AM1DV3 - 3060; ; Calibrated: 2011/1/18
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn861; Calibrated: 2011/8/29
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Scans/y (transversal) fine 3mm 6 x 42/ABM [HAC-2007] SNR(x,y,z) (3x15x1):

ABM1/ABM2 = 49.10 dB

ABM1 comp = 9.73 dB A/m

Location: 1.2, 5.3, 3.7 mm



0 dB = 1.000A/m



APPENDIX B: SYSTEM CERTIFICATE & CALIBRATION



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 **B.V. ADT (Auden)**

Certificate No: **DAE4-861_Aug11**

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BJ - SN: 861**

Calibration procedure(s) **QA CAL-06.v23
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **August 29, 2011**

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	28-Sep-10 (No:10376)	Sep-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1004	08-Jun-11 (in house check)	In house check: Jun-12

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bornholt	R&D Director	

Issued: August 29, 2011

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



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**

Glossary

DAE data acquisition electronics
Connector angle information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
 - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
 - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
 - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
 - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
 - *Input Offset Measurement:* Output voltage and statistical results over a large number of zero voltage measurements.
 - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
 - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
 - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
 - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 μ V, full range = -100...+300 mV

Low Range: 1LSB = 61nV, full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.369 \pm 0.1% (k=2)	404.758 \pm 0.1% (k=2)	405.720 \pm 0.1% (k=2)
Low Range	4.01191 \pm 0.7% (k=2)	4.00807 \pm 0.7% (k=2)	4.02061 \pm 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	126.0 $^{\circ}$ \pm 1 $^{\circ}$
---	-------------------------------------

Appendix

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	200003.7	2.18	0.00
Channel X + Input	19998.70	-2.10	-0.01
Channel X - Input	-20000.72	-0.82	0.00
Channel Y + Input	200003.3	3.09	0.00
Channel Y + Input	19997.06	-2.54	-0.01
Channel Y - Input	-20001.61	-1.81	0.01
Channel Z + Input	200001.0	1.32	0.00
Channel Z + Input	19998.31	-1.39	-0.01
Channel Z - Input	-20000.55	-0.75	0.00

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2000.2	0.12	0.01
Channel X + Input	200.25	0.05	0.02
Channel X - Input	-198.30	1.80	-0.90
Channel Y + Input	2000.4	0.44	0.02
Channel Y + Input	198.69	-1.21	-0.60
Channel Y - Input	-200.48	-0.48	0.24
Channel Z + Input	2000.1	0.13	0.01
Channel Z + Input	199.88	-0.22	-0.11
Channel Z - Input	-201.71	-1.81	0.91

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	5.00	3.52
	- 200	-2.54	-4.10
Channel Y	200	0.95	1.43
	- 200	-2.77	-2.63
Channel Z	200	-9.47	-9.71
	- 200	7.61	7.59

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	4.12	-0.79
Channel Y	200	2.04	-	4.95
Channel Z	200	1.95	-0.33	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15976	16003
Channel Y	16064	16134
Channel Z	16042	16211

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	-0.28	-2.06	1.31	0.64
Channel Y	-0.44	-1.89	2.45	0.60
Channel Z	-1.18	-2.63	1.47	0.74

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9



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
Client **B.V. ADT (Auden)**

Accreditation No.: **SCS 108**

Certificate No: **AM1DV3-3060_Jan11**

CALIBRATION CERTIFICATE

Object **AM1DV3 - SN: 3060**

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

Calibration date: **January 18, 2011**

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	28-Sep-10 (No:10376)	Sep-11
Reference Probe AM1DV3	SN: 3000	6-Sep-10 (No. AM1D-3000_Sep10)	Sep-11
DAE4	SN: 781	20-Oct-10 (No. DAE4-781_Oct10)	Oct-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
AMCC	1050	15-Oct-09 (in house check Oct-09)	Oct-11

Calibrated by:	Name Mike Meili	Function Laboratory Technician	Signature
Approved by:	Name Fin Bomholt	R&D Director	

Issued: January 19, 2011

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 10 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	AM1DV3 Audio Magnetic 1D Field Probe
Type No	SP AM1 001 BA
Serial No	3060

Overall length	296 mm
Tip diameter	6.0 mm (at the tip)
Sensor offset	3.0 mm (centre of sensor from tip)
Internal Amplifier	20 dB

Manufacturer / Origin	Schmid & Partner Engineering AG, Zürich, Switzerland
Manufacturing date	Oct-2008
Last calibration date	January 21, 2010

Calibration data

Connector rotation angle	(in DASY system)	50.5 °	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	0.82 °	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	0.00733 V / (A/m)	+/- 2.2 % (k=2)