

Hearing Aid Compatibility (HAC) T-Coil Test Report

APPLICANT : TCL Communication Ltd
EQUIPMENT : GSM Quad-band / UMTS Quad-band /
LTE hexa-band mobile phone
BRAND NAME : alcatel
MODEL NAME : 6055U
FCC ID : 2ACCJA018
STANDARD : FCC 47 CFR §20.19
ANSI C63.19-2011

We, SPORTON INTERNATIONAL (KUNSHAN) INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL (KUNSHAN) INC., the test report shall not be reproduced except in full.



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Appendix A. Plots of T-Coil Measurement

Appendix B. DASY Calibration Certificate

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
HA642504B	Rev. 01	Initial issue of report	May 27, 2016

1. Attestation of Test Results

Applicant Name	TCL Communication Ltd
Equipment Name	GSM Quad-band / UMTS Quad-band / LTE hexa-band mobile phone
Brand Name	alcatel
Model Name	6055U
FCC ID	2ACCJA018
IMEI Code	014658000003987
HW Version	PIO
SW Version	010 01
EUT Stage	Identical Prototype
Exposure category	General Population/Uncontrolled Exposure
HAC Rating	T4
Date Tested	2016/4/30~2016/5/14
Test Result	Pass

The device is compliance with HAC limits specified in guidelines FCC 47CFR §20.19 and ANSI Standard ANSI C63.19.

2. Administration Data

Testing Laboratory	
Test Site	SPORTON INTERNATIONAL (KUNSHAN) INC.
Test Site Location	No. 3-2, PingXiang Road, Kunshan, Jiangsu Province, P. R. China TEL: +86-0512-5790-0158 FAX: +86-0512-5790-0958
Test Site No.	Sporton Site No. : SAR01-KS
Applicant	
Company Name	TCL Communication Ltd
Address	5F, C building, No. 232, Liang Jing Road ZhangJiang High-Tech Park, Pudong Area Shanghai, P.R. China. 201203
Manufacturer	
Company Name	TCL Communication Ltd
Address	5F, C building, No. 232, Liang Jing Road ZhangJiang High-Tech Park, Pudong Area Shanghai, P.R. China. 201203

3. General Information

3.1 Description of Equipment Under Test (EUT)

Product Feature & Specification	
Frequency Band	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz WCDMA Band IV: 1712.4 MHz ~ 1752.6 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824.7 MHz ~ 848.3 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 12: 699.7 MHz ~ 715.3 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5805 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC : 13.56 MHz
Mode	· GSM/GPRS/EGPRS · RMC/AMR 12.2Kbps · HSDPA · HSUPA · HSPA+ (16QAM uplink is not supported) · LTE: QPSK, 16QAM · 802.11b/g/n HT20/HT40 · 802.11a/n HT20/HT40 · 802.11ac VHT20/VHT40/VHT80 · Bluetooth v3.0+EDR, Bluetooth v4.0 LE, Bluetooth 4.2 LE · NFC: ASK
Note: 1. This device supports VoLTE function.	

**3.2 Accessories and Support Equipment**

Specification of Accessory				
AC Adapter	Brand Name	alcatel	Model Name	UC13US
	Power Rating	I/P: 100-240Vac, 500mA, O/P: 5Vdc, 2000mA		
	P/N	CBA0059AG8C1		
Battery 1	Brand Name	ALCATEL onetouch	Model Name	TLp026EJ
	Power Rating	3.85Vdc, 2610mAh		
Battery 2	Brand Name	ALCATEL onetouch	Model Name	TLp026E2
	Power Rating	3.84Vdc, 2610mAh		
USB Cable	Brand Name	N/A	Model Name	CDA0000049C2
	Signal Line Type	1.0m shielded without core		

3.3 Air Interface and Operating Mode

Air Interface	Band MHz	Type	C63.19 Tested	Simultaneous Transmitter	OTT	Power Reduction
GSM	850	VO	Yes	WLAN, BT	NA	No
	1900			WLAN, BT	NA	Yes
	GPRS/EDGE	DT	No	WLAN, BT	Yes	Yes
WCDMA	Band V	VO	Yes	WLAN, BT	NA	No
	Band IV			WLAN, BT	NA	Yes
	Band II			WLAN, BT	NA	Yes
	HSPA	DT	No	WLAN, BT	Yes	Yes
LTE	Band 2	VD	Yes ⁽¹⁾	WLAN, BT	Yes	Yes
	Band 4			WLAN, BT		Yes
	Band 5			WLAN, BT		No
	Band 7			WLAN, BT		Yes
	Band 12			WLAN, BT		No
WLAN	2450	VD	Yes ⁽¹⁾	GSM, WCDMA,LTE	Yes	No
	5200			GSM, WCDMA,LTE		No
	5300			GSM, WCDMA,LTE		No
	5500			GSM, WCDMA,LTE		No
	5800			GSM, WCDMA,LTE		No
BT	2450	DT	No	GSM, WCDMA,LTE	NA	No

VO=CMRS Voice Service

DT=Digital Transport

VD=CMRS IP Voice Service and Digital Transport

Remark:

- No Associated T-Coil measurement has been made in accordance with KDB 285076 D02 T-Coil testing for CMRS IP

3.4 Applied Standards

- FCC CFR47 Part 20.19
- ANSI C63.19 2011-version
- FCC KDB 285076 D01 HAC Guidance v04r01
- FCC KDB 285076 D02 T Coil testing for CMRS IP v02

4. HAC T-Coil

FCC wireless hearing aid compatibility rules ensure that consumers with hearing loss are able to access wireless communications services through a wide selection of handsets without experiencing disabling radio frequency (RF) interference or other technical obstacles.

To define and measure the hearing aid compatibility of handsets, in CFR47 part 20.19 ANSI C63.19 is referenced. A handset is considered hearing aid-compatible for acoustic coupling if it meets a rating of at least M3 under ANSI C63.19, and A handset is considered hearing aid compatible for inductive coupling if it meets a rating of at least T3.

For inductive coupling, the wireless communication devices should be measured as below.

- 1) Magnetic signal strength in the audio band
- 2) Magnetic signal frequency response through the audio band
- 3) Magnetic signal to noise

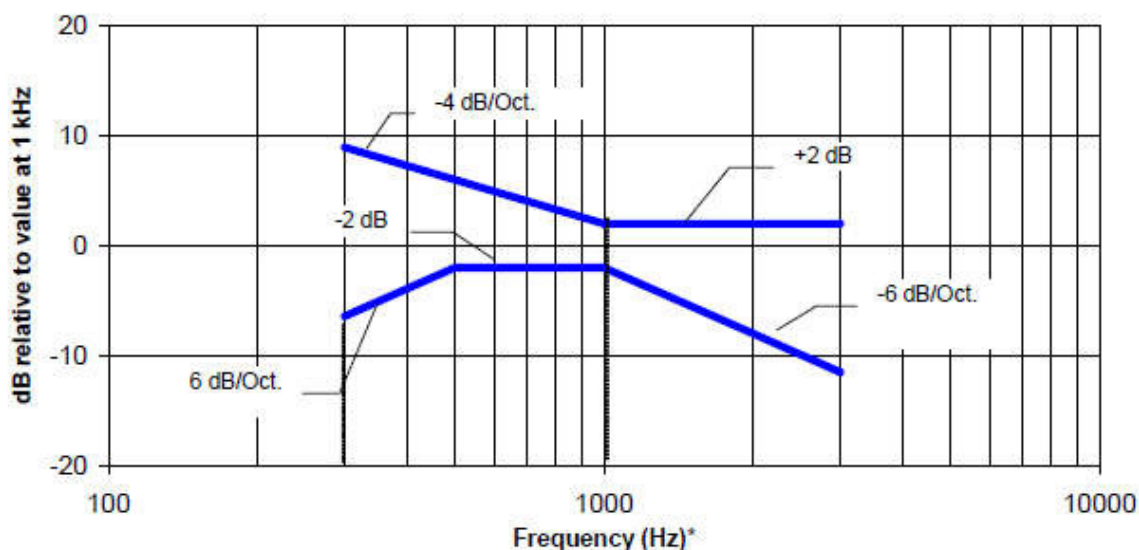
4.1 T-Coil Coupling Field Intensity

When measured as specified in this standard, the T-Coil signal shall be ≥ -18 dB (A/m) at 1 kHz, in a 1/3 octave band filter for all orientations.

4.2 T-Coil Frequency Response

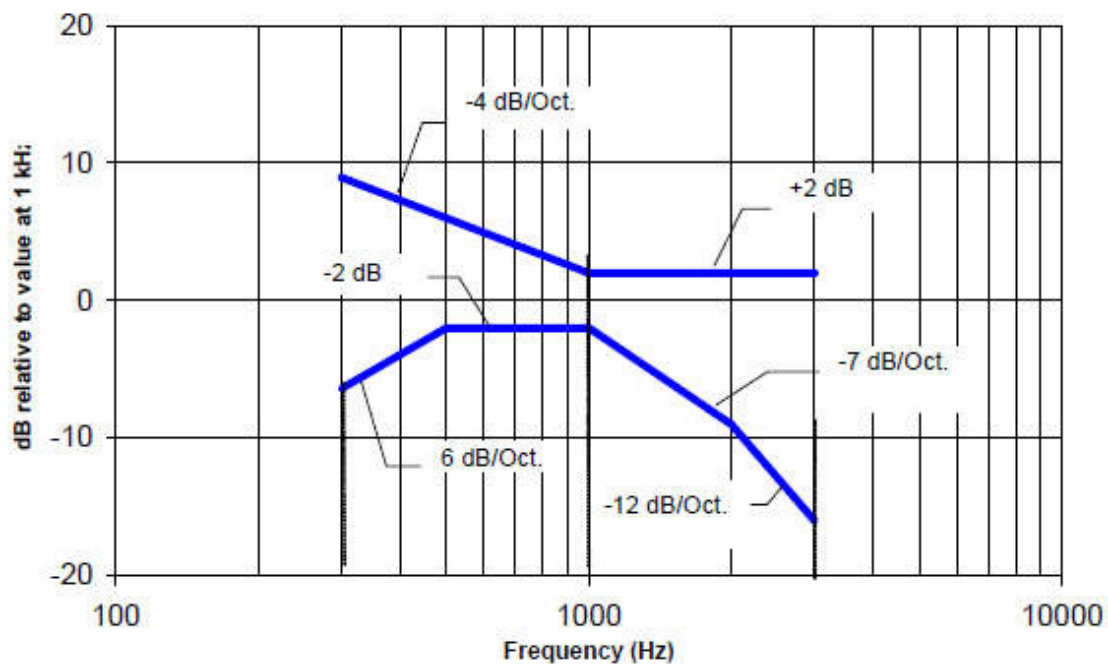
The frequency response of the perpendicular component of the magnetic field, measured in 1/3 octave bands, shall follow the response curve specified in this sub-clause, over the frequency range 300 Hz to 3000 Hz.

Figure 4.1 and Figure 4.2 provide the boundaries as a function of frequency. These response curves are for true field-strength measurements of the T-Coil signal. Thus, the 6 dB/octave probe response has been corrected from the raw readings.



NOTE—The frequency response is between 300 Hz and 3000 Hz.

Fig. 4.1 Magnetic field frequency response for WDs with field strength ≤ -15 dB at 1 KHz



NOTE—The frequency response is between 300 Hz and 3000 Hz.

Fig. 4.2 Magnetic field frequency response for WDs with a field that exceeds -15 dB(A/m) at 1 kHz

4.3 T-Coil Signal Quality Categories

This section provides the signal quality requirement for the intended T-Coil signal from a WD. Only the RF immunity of the hearing aid is measured in T-Coil mode. It is assumed that a hearing aid can have no immunity to an interference signal in the audio band, which is the intended reception band for this mode. A device is assessed beginning by determining the category of the RF environment in the area of the T-Coil source.

The RF measurements made for the T-Coil evaluation are used to assign the category T1 through T4. The limitation is given in Table 4.3. This establishes the RF environment presented by the WD to a hearing aid.

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

Table 4.3 T-Coil Signal Quality Categories

5. Measurement System Specification

5.1 System Configuration



Fig. 5.1 T-Coil setup with HAC Test Arch and AMCC

5.2 Test Arch Phantom

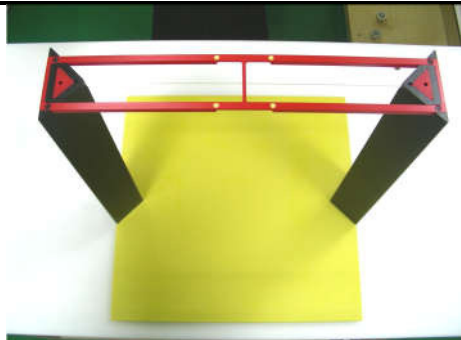
Construction :	Enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot.	
Dimensions :	370 x 370 x 370 mm	

Fig. 5.2 Photo of Arch Phantom

5.3 AMCC

The Audio Magnetic Calibration coil is a Helmholtz Coil designed 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 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.

Port description		
Signal	Connector	Resistance
Coil In	BNC	typically 50 Ohm
Coil Monitor	BNO	10 Ohm $\pm 1\%$ (100mV corresponding to 1 A/m)
Specification		
Dimensions	370 x 370 x 196 mm, according to ANSI C63.19	

5.4 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).

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

5.5 AMMI



Fig. 5.3 AMMI front panel

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 (vis PC)
Calibration	Auto-calibration/full system calibration using AMCC with monitor output
Dimensions	482 x 65 x 270 mm

5.6 System Hardware

DAE
The data acquisition electronics (DAE) 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.
Robot
The SPEAG DASY system uses the high precision robots (DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY5: CS8c) from Stäubli is used.

5.7 Cabling of System for GSM / UMTS / CDMA

The principal cabling of the T-Coil setup is shown in Fig. 5.4 All cables provided with the basic setup have a length of approximately 5 m.

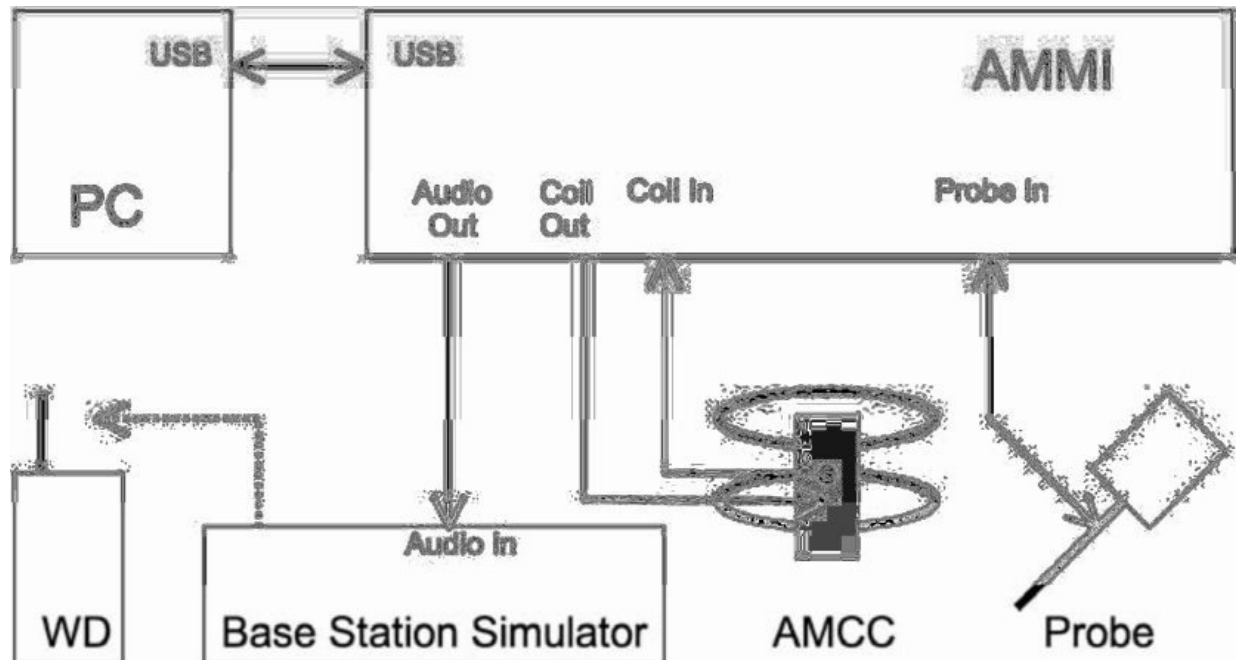


Fig. 5.4 T-Coil setup cabling

5.8 Cabling of System for VoLTE

The principal cabling of the T-Coil setup is shown in Fig. 5.5 All cables provided with the basic setup have a length of approximately 5 m.

**5.9 Test Equipment List**

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Data Acquisition Electronics	DAE4	1210	May 21, 2015	May 20, 2016
SPEAG	Data Acquisition Electronics	DAE4	917	Dec 14, 2015	Dec 13, 2016
SPEAG	Active Audio Magnetic Field Prober	AM1DV3	3093	May 21, 2015	May 20, 2016
SPEAG	Active Audio Magnetic Field Prober	AM1DV3	3128	Jan 12, 2016	Jan 11, 2016
SPEAG	Test Arch Phantom	Par phantom	1105	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
R&S	Universal Radio Communication Tester	CMU200	116456	Aug 10, 2015	Aug 09, 2016
SPEAG	Audio Magnetic Measuring Instrument	AMMI	1128	NA	NA
SPEAG	Helmholtz calibration coil	AMCC	NA	NA	NA

Table 5.1 Test Equipment List**Note:**

1. NCR: "No-Calibration Required"

5.10 Probe Calibration in AMCC

The probe sensitivity at 1 kHz is 0.06556 V/(A/m) (-23.66 dBV/(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 Fig. 5.5. 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 Annex B (AM1D probe: SPAM100AF) (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, SDHACPO02A as shown in Annex B.

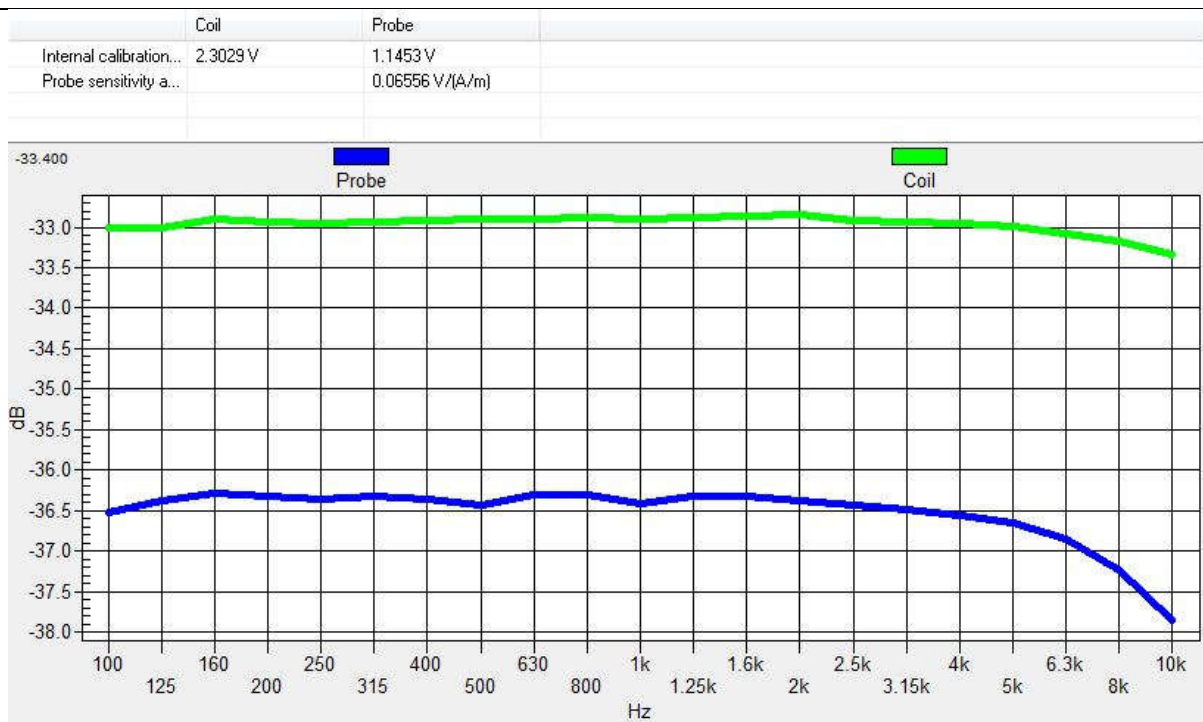


Fig. 5.5 The frequency response and sensitivity of AM1D probe

5.11 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 below Fig. 5.6 and Fig. 5.7. 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 EUT response.

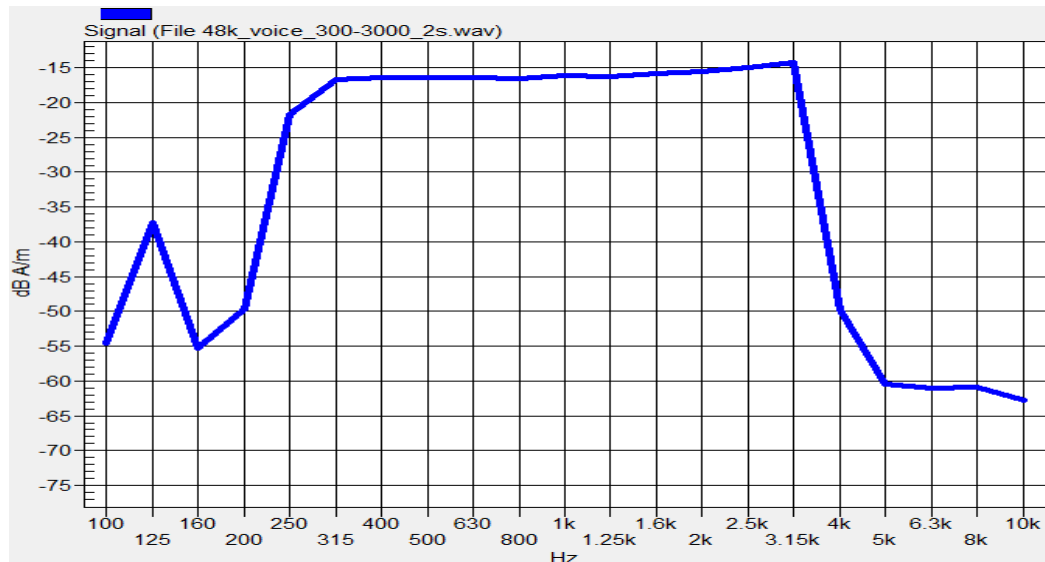


Fig. 5.6 Audio signal spectrum of the broadband signal (48kHz_voice_300Hz~3 kHz)

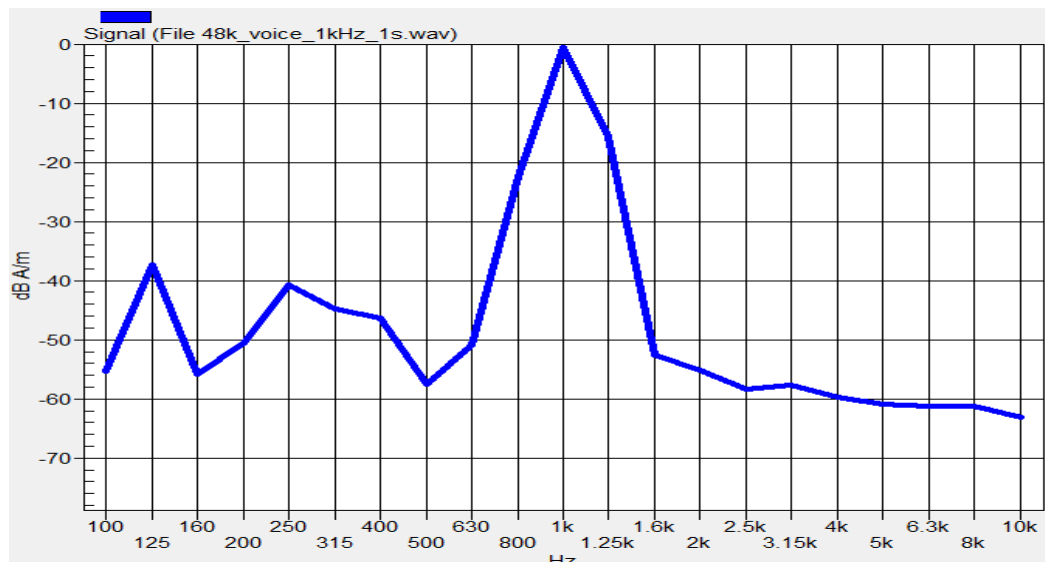


Fig. 5.7 Audio signal spectrum of the narrowband signal (48kHz_voice_1kHz)

5.12 Establish Reference Level

According to ANSI C63.19:2011 section 7.4.2.1, 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 1 kHz 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.

Determine the 1 kHz input level to generate the desired signal level of -16 dBm 0. 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 multimeter display "Coil signal". With Gain 10 setting, the measurement signal difference to the desired signal level of -16 dBm 0.

GSM/UMTS Calculations:

$$3.14 \text{ dBm0} = -2.44 \text{ dBV} \rightarrow -16 \text{ dBm0} = -21.58 \text{ dBV}$$

$$\text{Gain 10} = -20.70 \text{ dBV}$$

$$-21.58 - (-20.70) = -0.88 \text{ dB}$$

$$10 * [10^{((-0.88) / 20)}] = 10 * 0.904 = 9.04$$

$$\text{Required Gain Factor} = 10^{(-\text{RMS(dB)}/20)}$$

$$\text{Gain Setting} = \text{Required Gain Factor} * 9.04$$

Note: Calculated Gain Setting = Resulting Gain * Required Gain Factor

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

Signal Type	Duration (s)	Peak to RMS (dB)	RMS (dB)	Required Gain Factor ⁽¹⁾	Calculated Gain Setting	Adjusted Gain Setting ⁽²⁾
48k_voice_1kHz	1	16.2	-12.7	4.33	39.13	39.13
48k_voice_300Hz ~ 3kHz	2	21.6	-18.6	8.48	76.63	76.63

Remark:

(1) The gain for the specific signal shall typically be multiplied by this factor to achieve approx. the same level as for the 1kHz sine signal

(2) If the measurement for each signal type with calculated gain setting does not meet the desired level, the gain setting will be manually adjusted until the desired level is obtained.



6. T-Coil Test Procedure

6.1 Test Process and Flow Chart

Referenced to ANSI C63.19-2011, Section 7.4

This section describes the procedures used to measure the ABM (T-Coil) performance of the WD. In addition to measuring the absolute signal levels, the A-weighted magnitude of the unintended signal shall also be determined. To assure that the required signal quality is measured, the measurement of the intended signal and the measurement of the unintended signal must be made at the same location for each measurement position. In addition, the RF field strength at each measurement location must be at or below that required for the assigned category.

Measurements shall not include undesired properties from the WD's RF field; therefore, use of a coaxial connection to a base station simulator or non-radiating load, there might still be RF leakage from the WD, which can interfere with the desired measurement. Pre-measurement checks should be made to avoid this possibility. All measurements shall be performed with the WD operating on battery power with an appropriate normal speech audio signal input level given in ANSI C63.19-2011 Table 7.1. If the device display can be turned off during a phone call, then that may be done during the measurement as well,

Measurement shall be performed at two locations specified in ANSI C63.19-2011 A.3, with the correct probe orientation for a particular location, in a multistage sequence by first measuring the field intensity of the desired T-Coil signal the same location as the desired ABM or T-Coil signal (ABM1), and the ratio of desired to undesired magnetic components (ABM2) must be measured at the same location as the desired ABM or T-Coil signal (ABM1), and the ratio of desired to undesired ABM signals must be calculated. For the perpendicular field location, only the ABM1 frequency response shall be determined in a third measurement stage.

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.

- a) A validation of the test setup and instrumentation may be performed using a TMFS or Helmholtz coil. Measure the emissions and confirm that they are within the specified tolerance.
- b) Position the WD in the test setup and connect the WD RF connector to a base station simulator or a non-radiating load. Confirm that equipment that requires calibration has been calibrated, and that the noise level meets the requirements given in ANSI C63.19-2011 clause 7.3.1.
- c) The drive level to the WD is set such that the reference input level specified in ANSI C63.19-2011 Table 7.1 is input to the base station simulator (or manufacturer's test mode equivalent) in 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 ANSI C63.19-2011 clause 7.4.2, shall be used for the reference audio signal. If interference is found at 1025 Hz an alternative nearby reference audio signal frequency may be used. The same drive level shall 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, provided that a signal at any frequency at maximum modulation would not result in clipping or signal overload.



- d) Determine the magnetic measurement locations for the WD device (A.3), if not already specified by the manufacturer, as described in ANSI C63.19-2011 clause 7.4.4.1.1 and 7.4.4.2.
- e) At each measurement location, measure and record the desired T-Coil magnetic signals (ABM1 at f_i) as described in ANSI C63.19-2011 clause 7.4.4.2 in each individual ISO 266-1975 R10 standard 1/3 octave band. The desired audio band input frequency (f_i) shall be centered in each 1/3 octave band maintaining the same drive level as determined in item c) and the reading taken for that band.

Equivalent methods of determining the frequency response may also be employed, such as fast Fourier transform (FFT) analysis using noise excitation or input-output comparison using simulated speech. The full-band integrated probe output, as specified in D.9, may be used, as long as the appropriate calibration curve is applied to the measured result, so as to yield an accurate measurement of the field magnitude. (The resulting measurement shall be an accurate measurement in dB A/m.)

All Measurements of the desired signal shall be shown to be of the desired signal and not of an undesired signal. This may be shown by turning the desired signal ON and OFF with the probe measuring the same location. If the scanning method is used the scans shall show that all measurement points selected for the ABM1 measurement meet the ambient and test system noise criteria in ANSI C63.19-2011 clause 7.3.1.

- f) At the measurement location for each orientation, measure and record the undesired broadband audio magnetic signal (ABM2) as specified in ANSI C63.19-2011 clause 7.4.4.4 with no audio signal applied (or digital zero applied, if appropriate) using A-weighting and the half-band integrator. Calculate the ratio of the desired to undesired signal strength (i.e., signal quality).
- g) Obtain the data from the postprocessor, SEMCAD, and determine the category that properly classifies the signal quality based on ANSI C63.19-2011 Table 8.5.

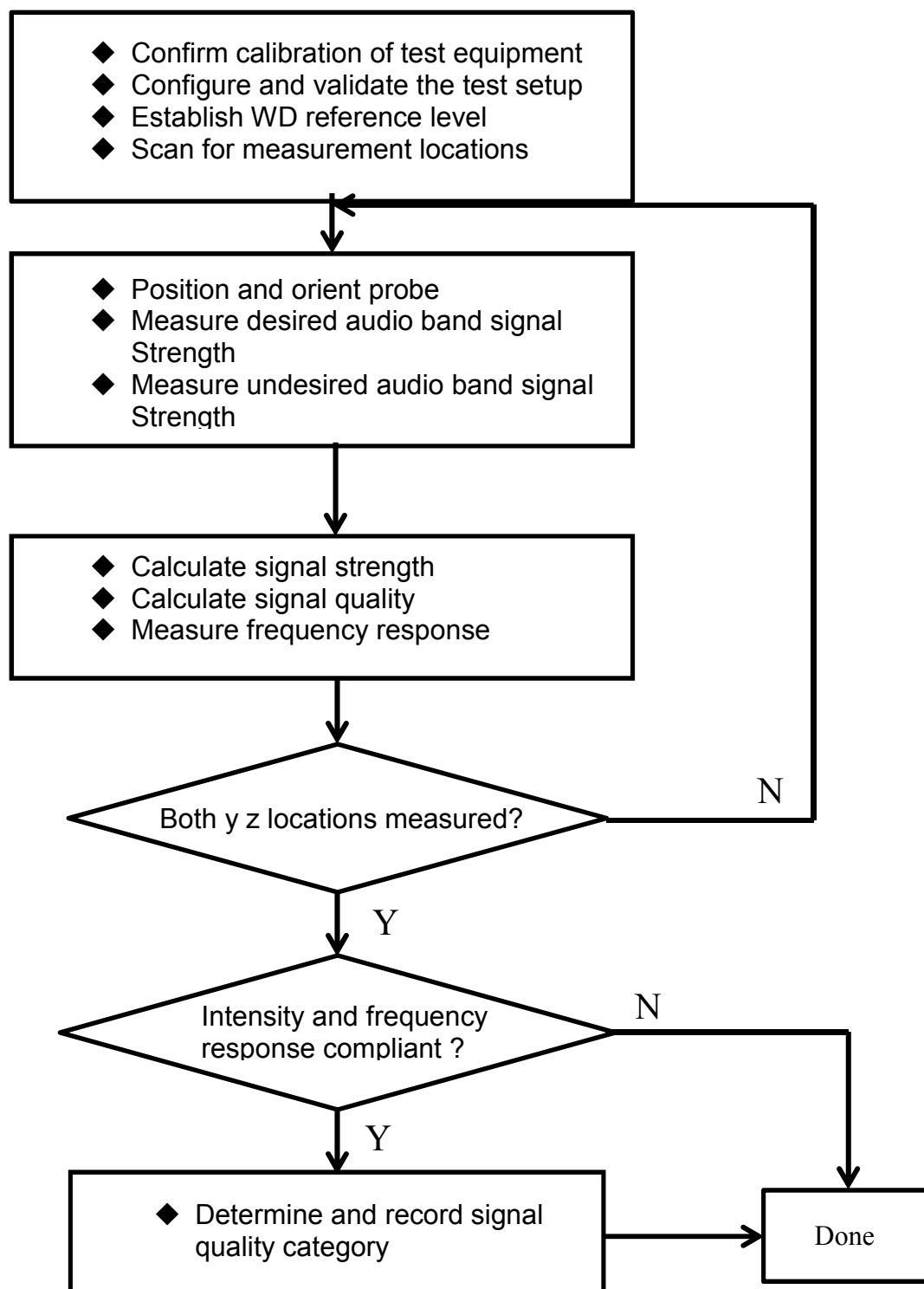


Fig. 6.1 Test Flow Chart

6.2 Description of EUT Test Position

Fig.6.2 illustrate the references and reference plane that shall be used in a typical EUT emissions measurement. The principle of this section is applied to EUT with similar geometry. Please refer to Appendix C for the setup photographs.

- ◆ The area is 5 cm by 5 cm.
- ◆ The area is centered on the audio frequency output transducer of the EUT.
- ◆ The area is in a reference plane, which is defined as the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It is parallel to the centerline of the receiver area of the phone and is defined by the points of the receiver-end of the EUT handset, which, in normal handset use, rest against the ear.
- ◆ The measurement plane is parallel to, and 10 mm in front of, the reference plane.

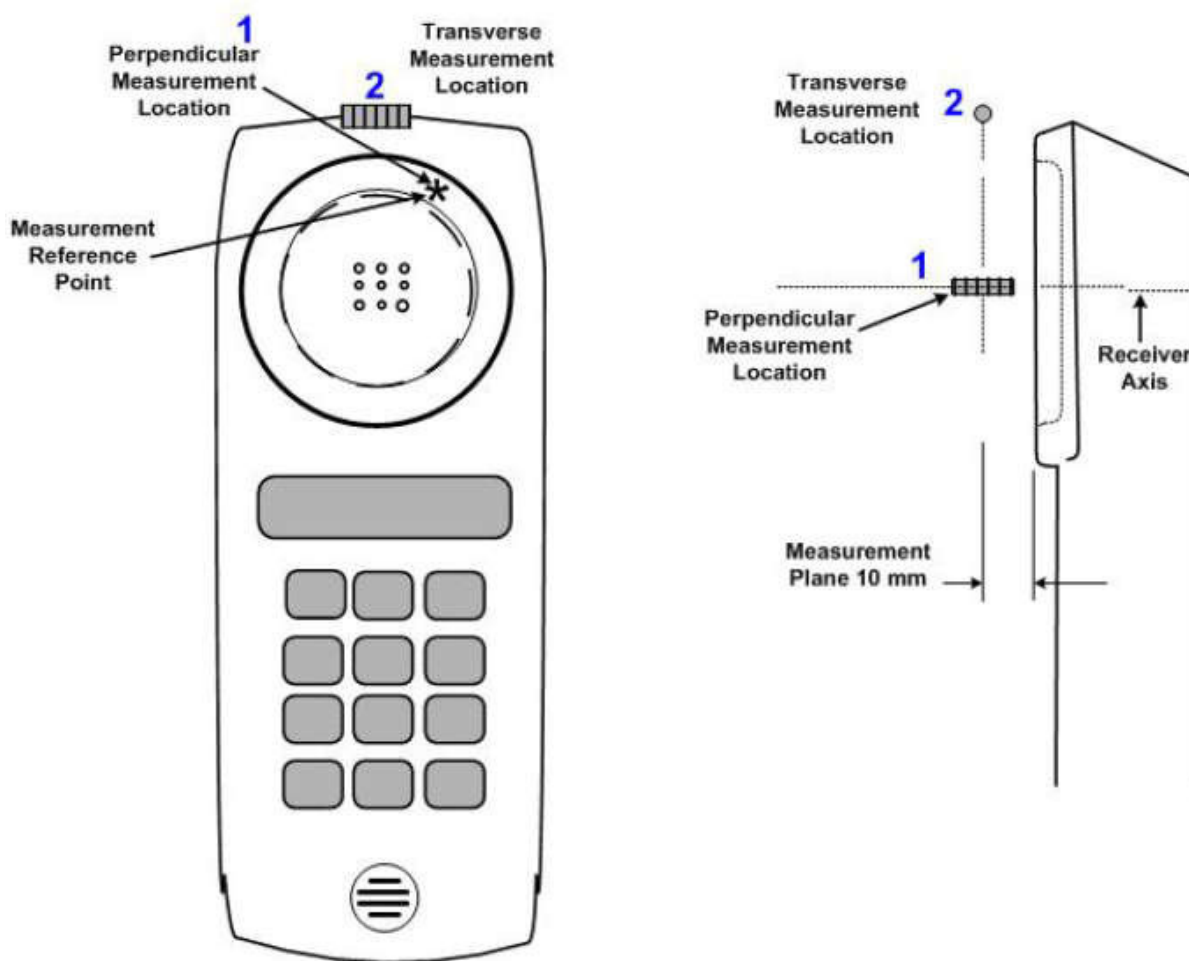


Fig 6.2 A typical EUT reference and plane for T-Coil measurements



7. HAC T-Coil Test Results

7.1 Magnitude Result

Plot No.	Air Interface	Operating Mode	Channel	Probe Position	ABM1 (dB A/m)	ABM2 (dB A/m)	SNR (dB)	Battery	Holster	T Rating
01	GSM850	Voice (speech codec /handset low)	189	Axial (Z)	5.09	-30.40	35.49	#1	-	T4
				Transversal (Y)	-3.47	-44.73	41.26	#1	-	T4
02	GSM1900	Voice (speech codec /handset low)	661	Axial (Z)	5.46	-34.03	39.49	#1	-	T4
				Transversal (Y)	-3.76	-45.78	42.02	#1	-	T4
03	WCDMA Band V	Voice (speech codec low)	4182	Axial (Z)	5.78	-42.60	48.38	#1	-	T4
				Transversal (Y)	-3.30	-46.45	43.15	#1	-	T4
04	WCDMA Band IV	Voice (speech codec low)	1413	Axial (Z)	5.69	-42.68	48.37	#1	-	T4
				Transversal (Y)	-2.82	-46.19	43.37	#1	-	T4
05	WCDMA Band II	Voice (speech codec low)	9400	Axial (Z)	5.39	-43.64	49.03	#1	-	T4
				Transversal (Y)	-3.34	-48.52	45.18	#1	-	T4
06	GSM850	Voice (speech codec /handset low)	189	Axial (Z)	5.81	-30.07	35.88	#2	-	T4
				Transversal (Y)	-2.51	-44.13	41.62	#2	-	T4
07	GSM1900	Voice (speech codec /handset low)	661	Axial (Z)	9.10	-33.09	42.19	#2	-	T4
				Transversal (Y)	2.22	-45.54	47.76	#2	-	T4
08	WCDMA Band V	Voice (speech codec low)	4182	Axial (Z)	9.47	-43.76	53.23	#2	-	T4
				Transversal (Y)	2.51	-46.49	49.00	#2	-	T4
09	WCDMA Band IV	Voice (speech codec low)	1413	Axial (Z)	9.40	-43.26	52.66	#2	-	T4
				Transversal (Y)	2.53	-47.27	49.80	#2	-	T4
10	WCDMA Band II	Voice (speech codec low)	9400	Axial (Z)	9.45	-43.45	52.90	#2	-	T4
				Transversal (Y)	2.50	-47.67	50.17	#2	-	T4
11	GSM850	Voice (speech codec /handset low)	189	Axial (Z)	3.59	-29.59	33.18	#1	With	T4
				Transversal (Y)	-5.00	-43.61	38.61	#1	With	T4
12	GSM1900	Voice (speech codec /handset low)	661	Axial (Z)	6.14	-34.10	40.24	#1	With	T4
				Transversal (Y)	-0.80	-44.81	44.01	#1	With	T4
13	WCDMA Band V	Voice (speech codec low)	4182	Axial (Z)	6.32	-43.03	49.35	#1	With	T4
				Transversal (Y)	-0.53	-45.78	45.25	#1	With	T4
14	WCDMA Band IV	Voice (speech codec low)	1413	Axial (Z)	6.16	-42.20	48.36	#1	With	T4
				Transversal (Y)	-0.60	-45.46	44.86	#1	With	T4
15	WCDMA Band II	Voice (speech codec low)	9400	Axial (Z)	6.14	-41.59	47.73	#1	With	T4
				Transversal (Y)	-0.60	-45.88	45.28	#1	With	T4

Remark:

1. There is special HAC mode software on this EUT.
2. Test Engineer : Fulu Hu

8. Uncertainty Assessment

The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance. The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances. Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is showed in Table 8.1.

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (ABM1)	Ci (ABM2)	Standard Uncertainty (ABM1)	Standard Uncertainty (ABM2)
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 Calibrate	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 Disturbation	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 %
EUT 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						± 4.1 %	± 6.1 %
Coverage Factor for 95 %						K = 2	
Expanded Uncertainty						± 8.1 %	± 12.3 %

Table 8.1 Uncertainty Budget of audio band magnetic measurement



9. References

- [1] ANSI C63.19-2011, "American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids", 27 May 2011.
- [2] FCC KDB 285076 D01v04r01, "Equipment Authorization Guidance for Hearing Aid Compatibility", Apr 2016
- [3] FCC KDB 285076 D02v02, "Guidance for Performing T-Coil tests for Air Interfaces Supporting Voice over IP", Apr 2016
- [4] SPEAG DASY System Handbook



Appendix A. Plots of T-Coil Measurement

The plots are shown as follows.

1 HAC T-Coil GSM850_Voice_Ch189(Z)_Battery 1

Communication System: UID 0, General GSM (0); Frequency: 836.4 MHz; Duty Cycle: 1:8.3

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

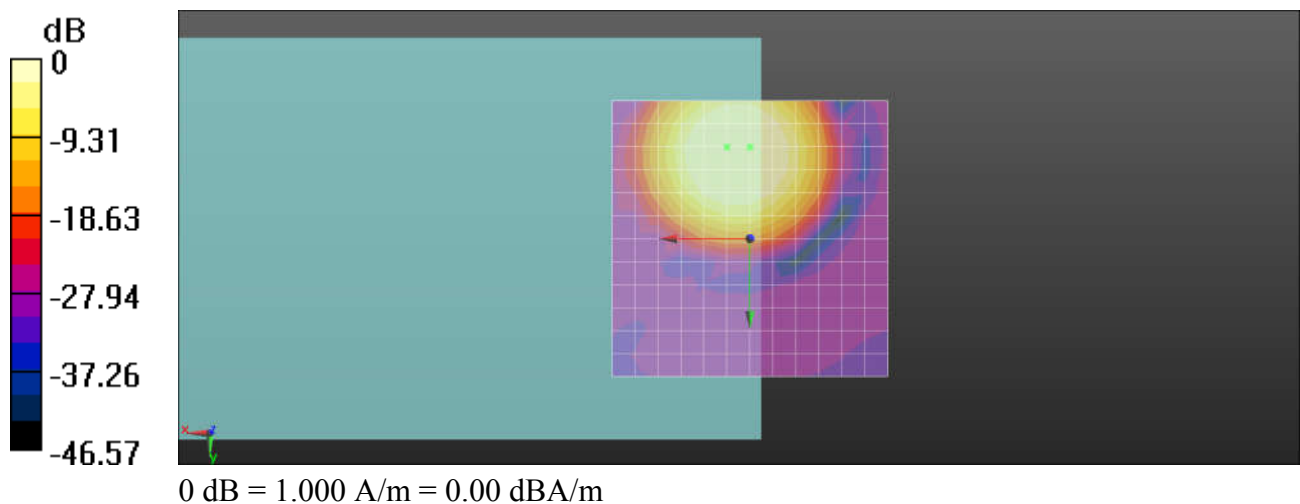
- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch189/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

ABM1/ABM2 = 35.49 dB

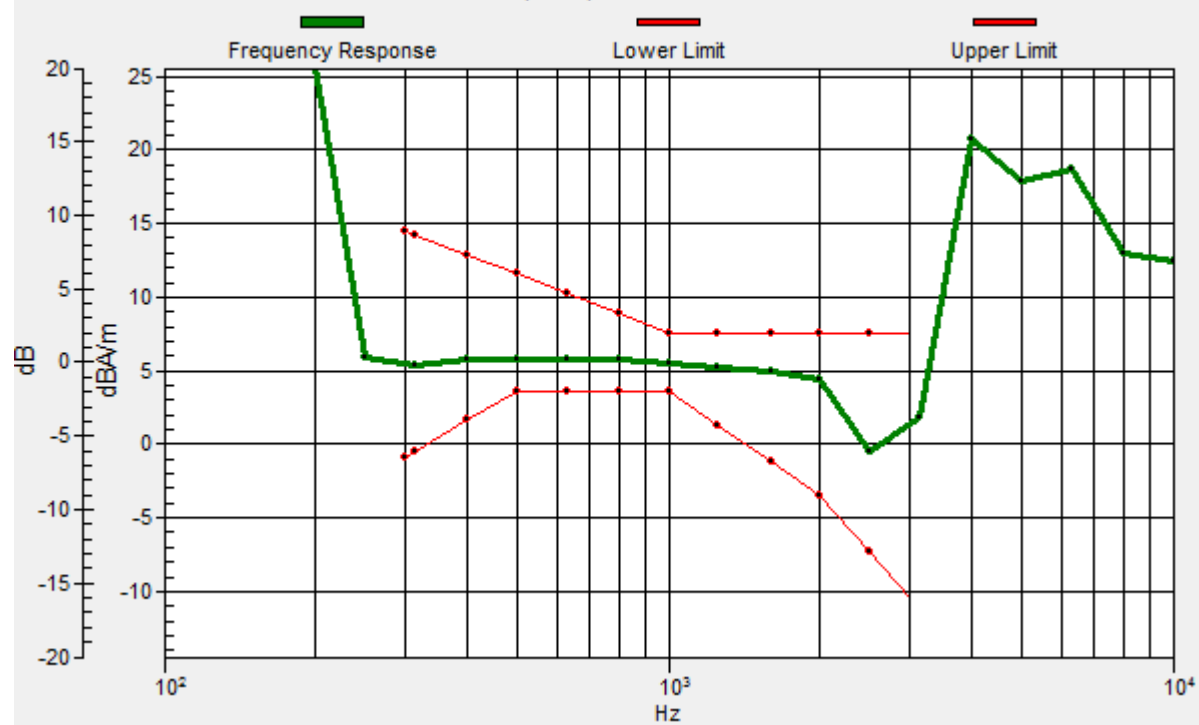
ABM1 comp = 5.09 dBA/m

Location: 0, -16.7, 3.7 mm



Ch189/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 0, -16.7, 3.7 mm Diff: 2dB



1 HAC T-Coil GSM850_Voice_Ch189(Y)_Battery 1

Communication System: UID 0, General GSM (0); Frequency: 836.4 MHz; Duty Cycle: 1:8.3

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

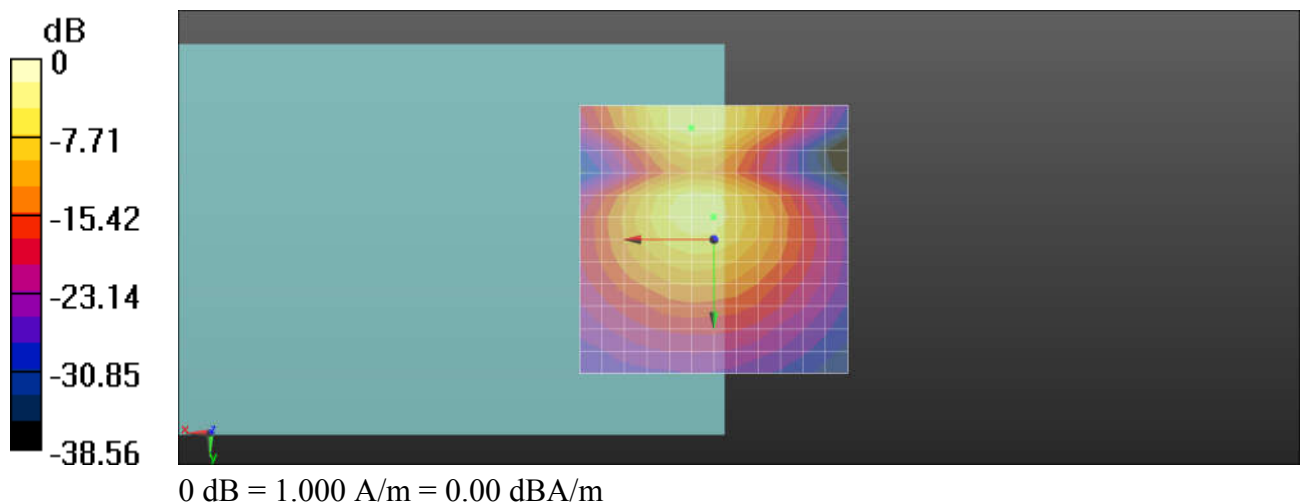
Ch189/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 41.26 dB

ABM1 comp = -3.47 dBA/m

Location: 0, -4.2, 3.7 mm



2 HAC T-Coil GSM1900_Voice_Ch661(Z)_Battery 1

Communication System: UID 0, General GSM (0); Frequency: 1880 MHz; Duty Cycle: 1:8.3

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

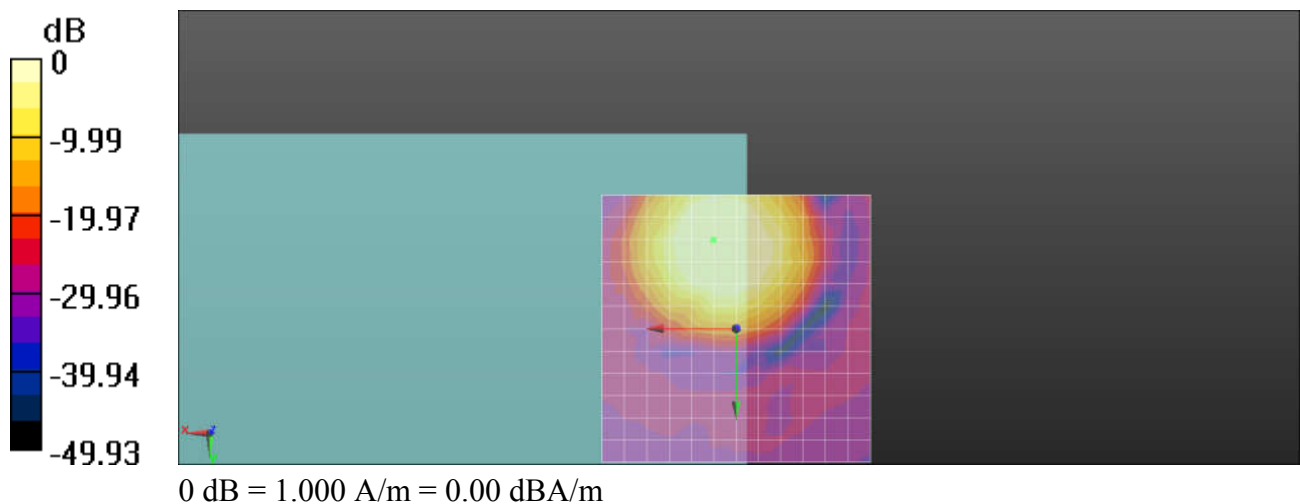
- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch661/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

ABM1/ABM2 = 39.49 dB

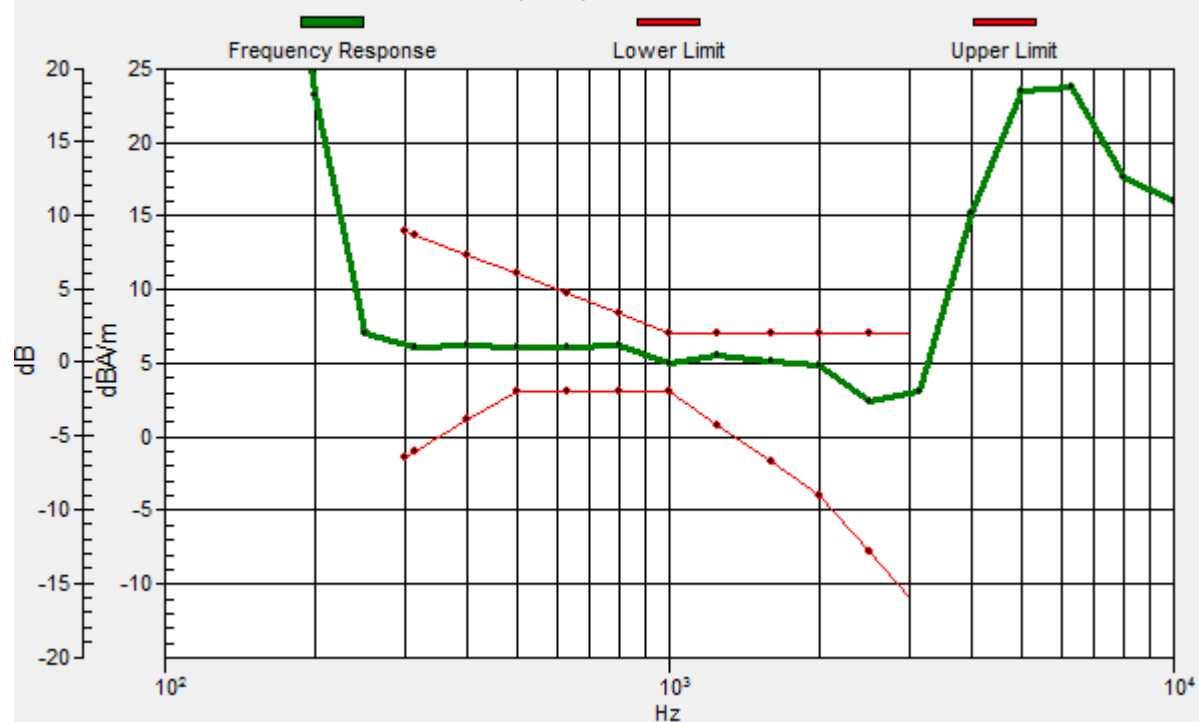
ABM1 comp = 5.46 dBA/m

Location: 4.2, -16.7, 3.7 mm



Ch661/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 4.2, -16.7, 3.7 mm Diff: 1.53dB



2 HAC T-Coil GSM1900_Voice_Ch661(Y)_Battery 1

Communication System: UID 0, General GSM (0); Frequency: 1880 MHz; Duty Cycle: 1:8.3

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

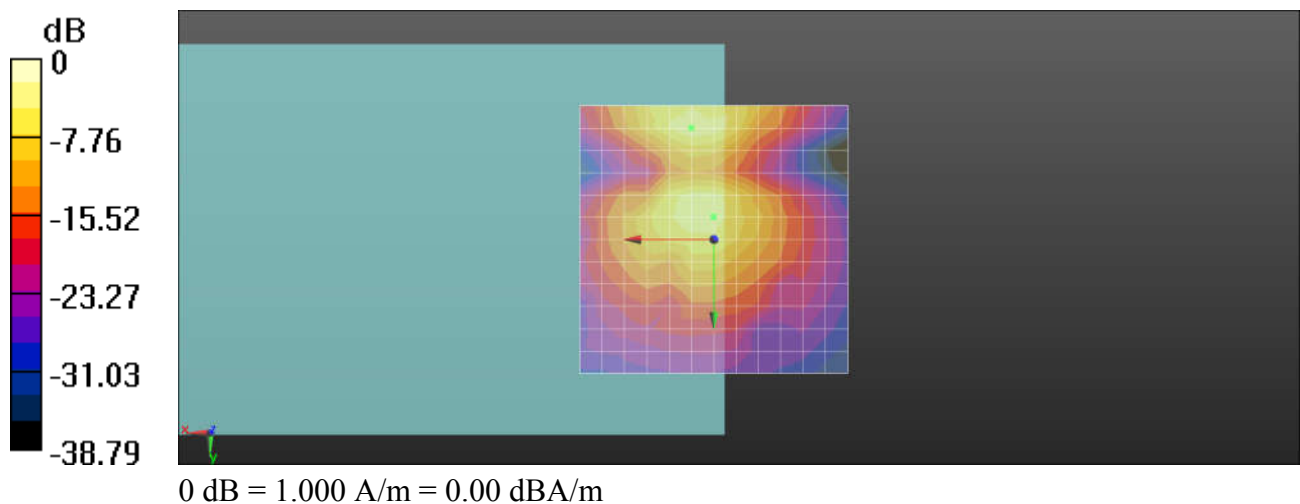
Ch661/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 42.02 dB

ABM1 comp = -3.76 dBA/m

Location: 0, -4.2, 3.7 mm



3 HAC T-Coil WCDMA V_Voice_Ch4182(Z)_Battery 1

Communication System: UID 0, UMTS (0); Frequency: 836.4 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

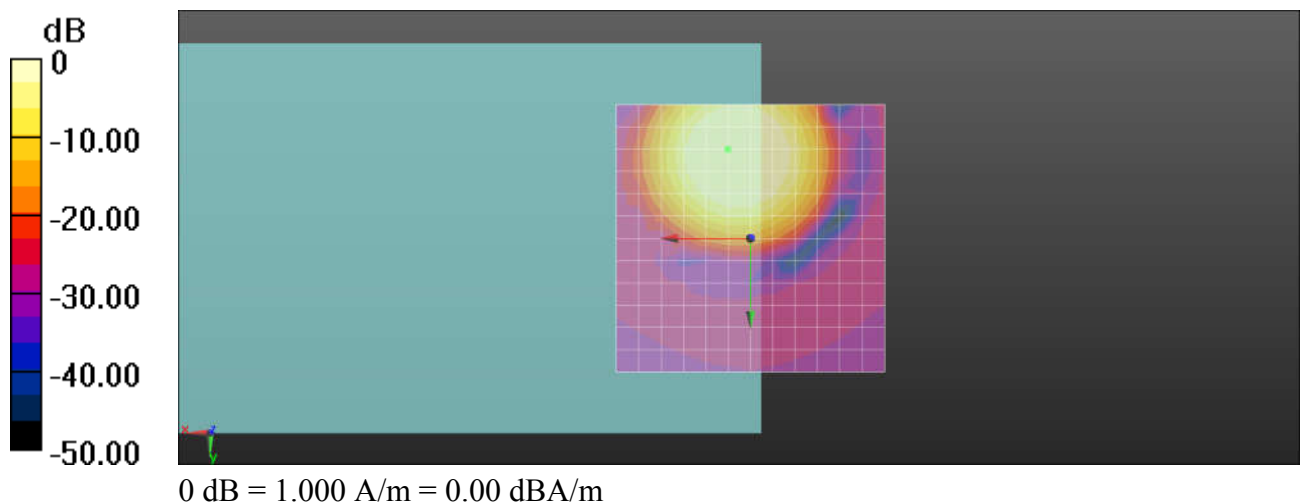
Ch4182/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 48.38 dB

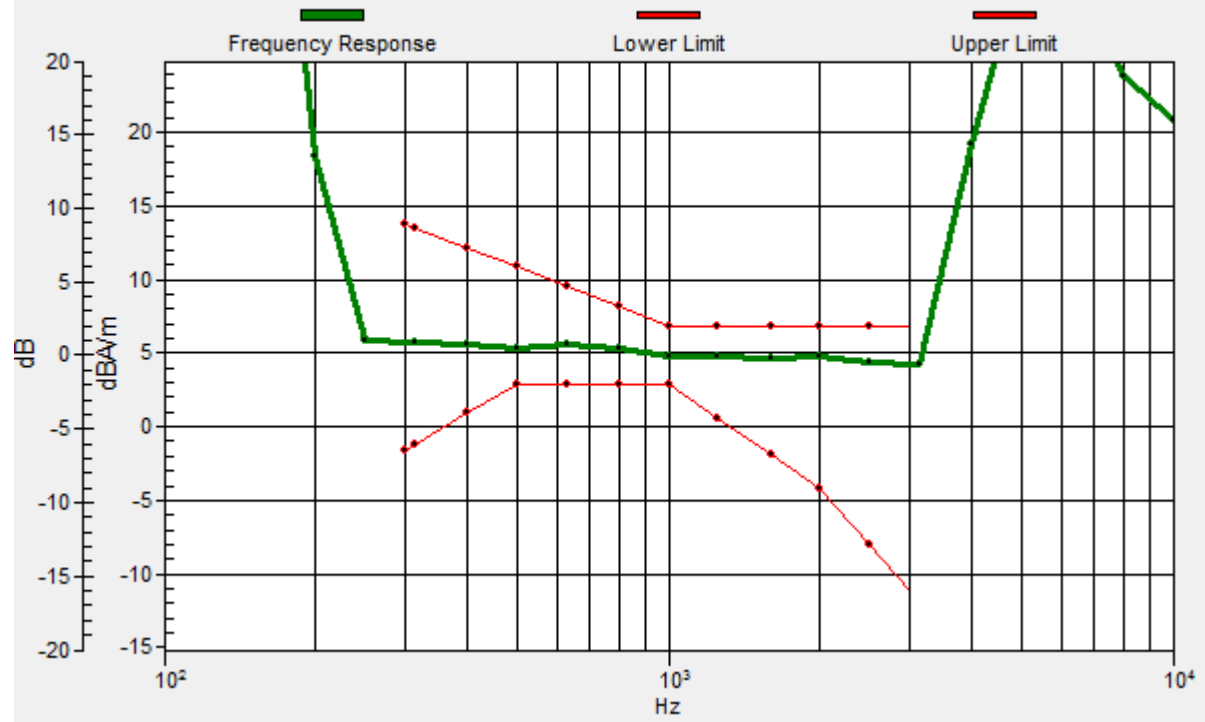
ABM1 comp = 5.78 dBA/m

Location: 4.2, -16.7, 3.7 mm



Ch4182/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 4.2, -16.7, 3.7 mm Diff: 2dB



3 HAC T-Coil WCDMA V_Voice_Ch4182(Y)_Battery 1

Communication System: UID 0, UMTS (0); Frequency: 836.4 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

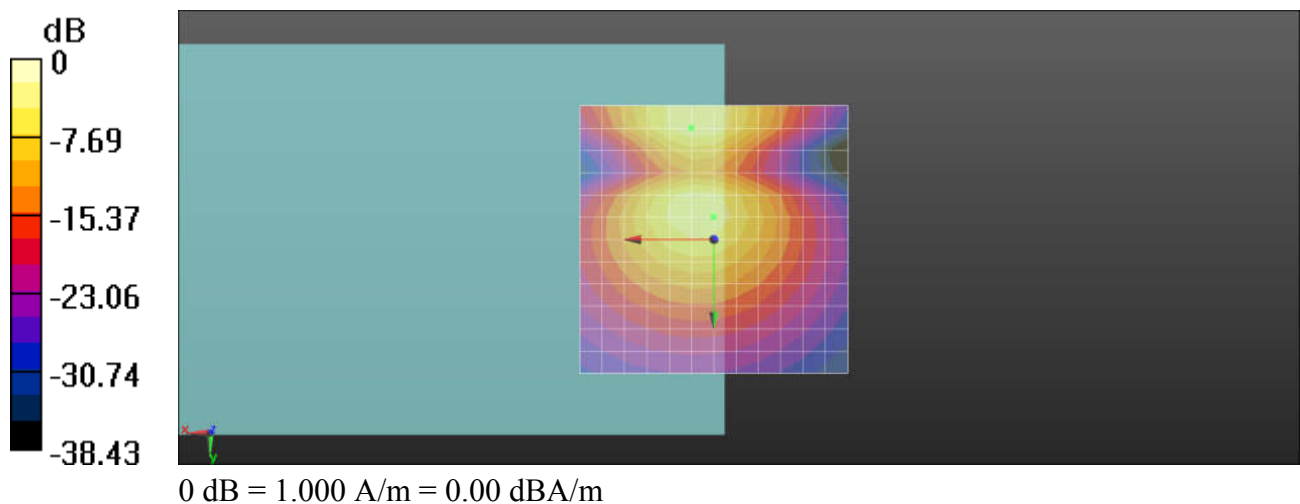
Ch4182/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 43.15 dB

ABM1 comp = -3.30 dBA/m

Location: 0, -4.2, 3.7 mm



4 HAC T-Coil WCDMA IV_Voice_Ch1413(Z)_Battery 1

Communication System: UID 0, UMTS (0); Frequency: 1732.6 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

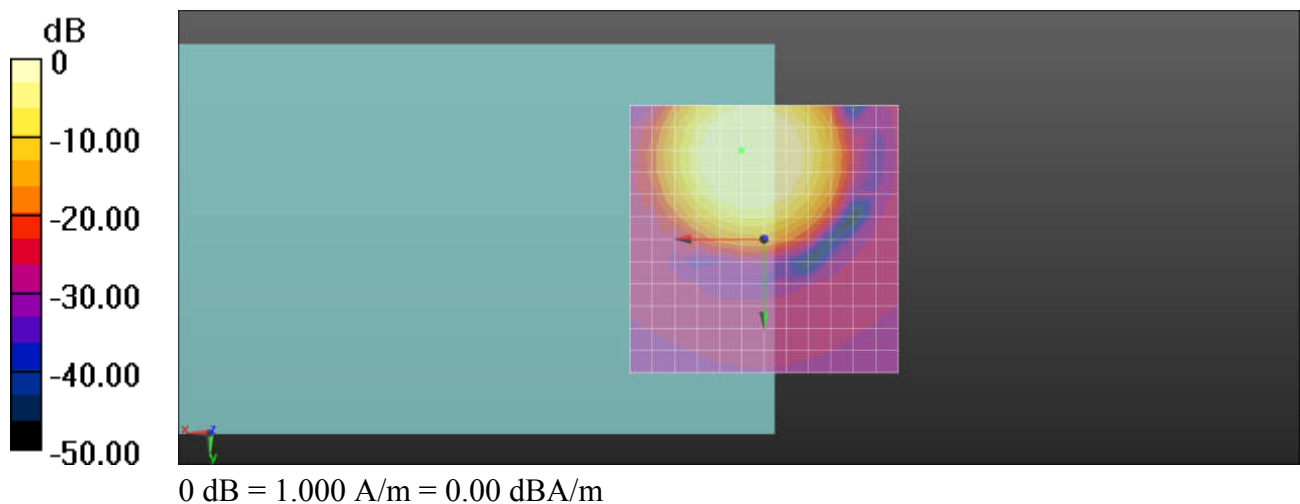
Ch1413/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 48.37 dB

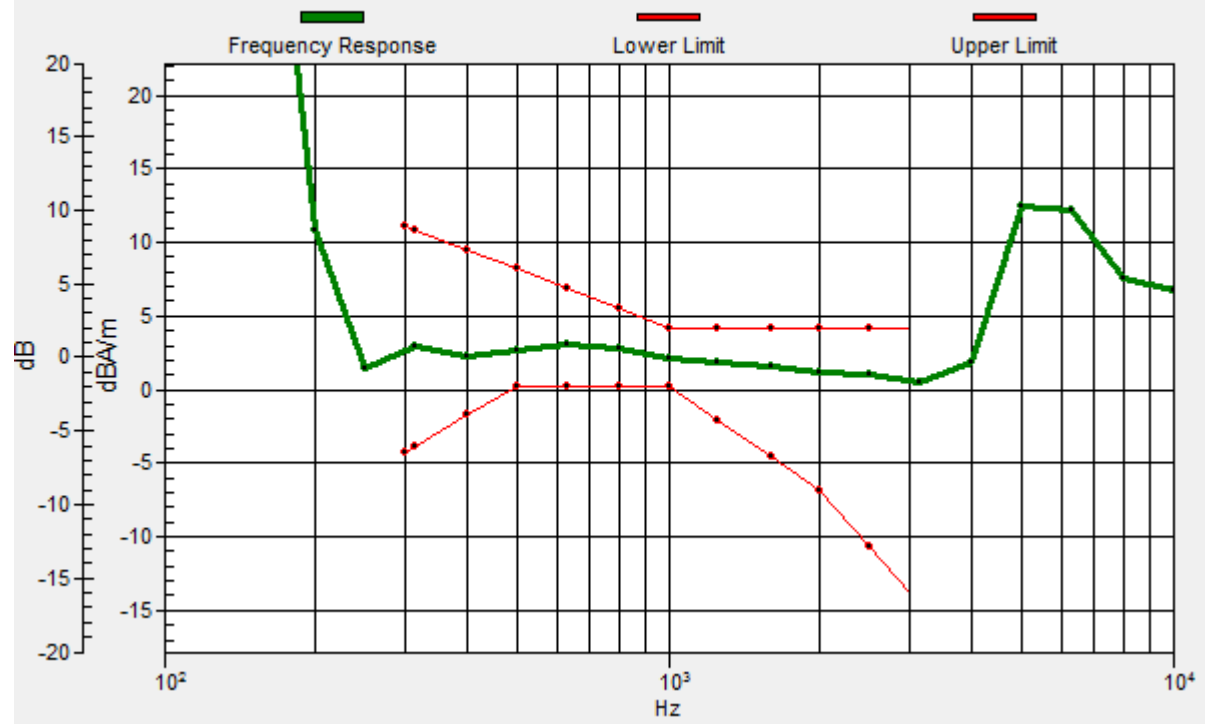
ABM1 comp = 5.69 dBA/m

Location: 4.2, -16.7, 3.7 mm



Ch1413/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 4.2, -16.7, 3.7 mm Diff: 2dB



4 HAC T-Coil WCDMA IV_Voice_Ch1413(Y)_Battery 1

Communication System: UID 0, UMTS (0); Frequency: 1732.6 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

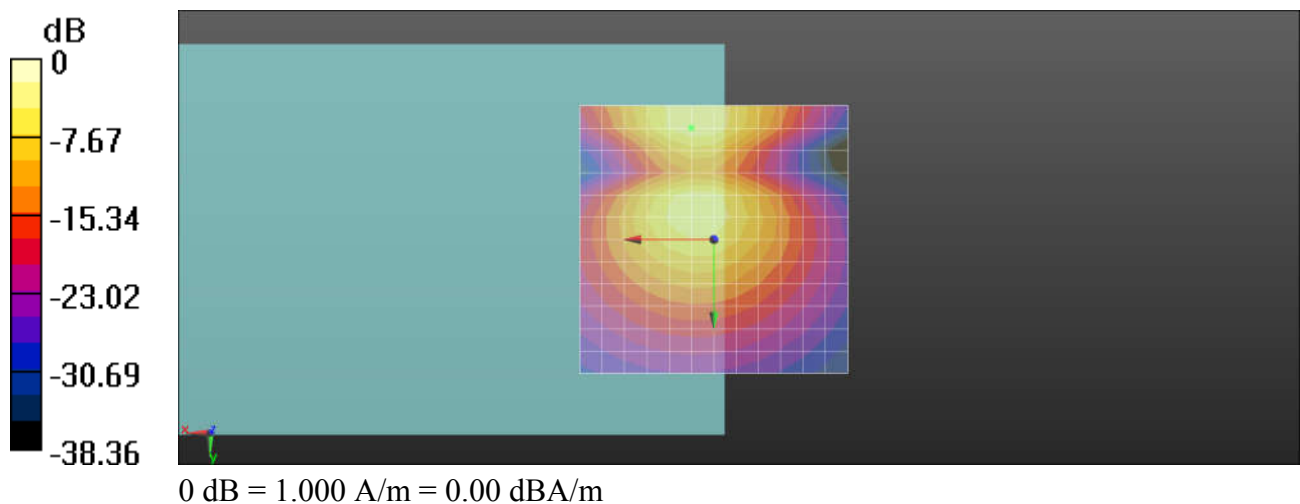
Ch1413/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 43.37 dB

ABM1 comp = -2.82 dBA/m

Location: 4.2, -20.8, 3.7 mm



5 HAC T-Coil WCDMA II_Voice_Ch9400(Z)_Battery 1

Communication System: UID 0, UMTS (0); Frequency: 1880 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

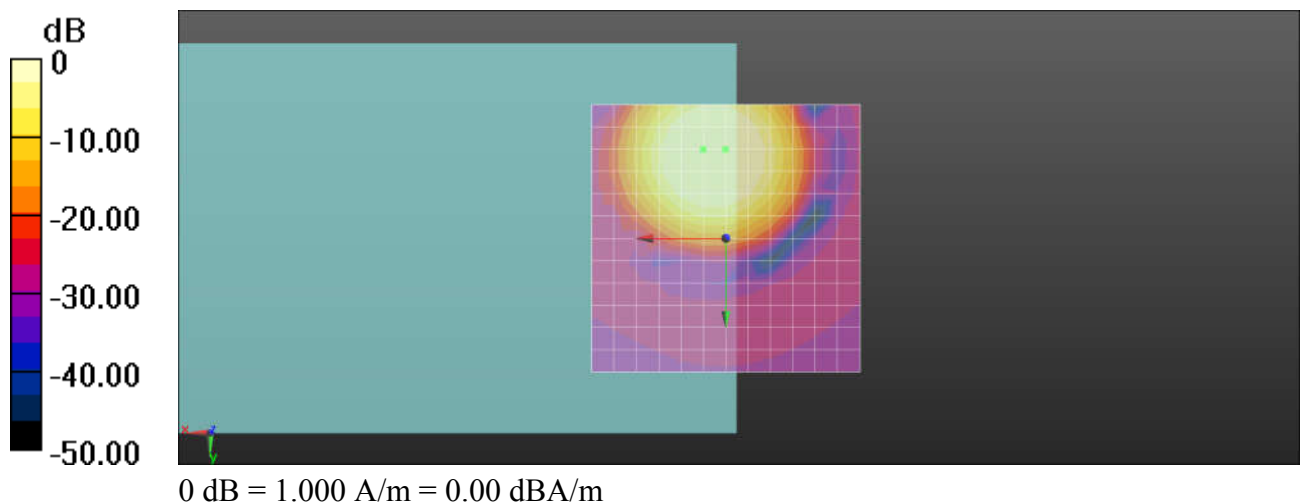
Ch9400/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 49.03 dB

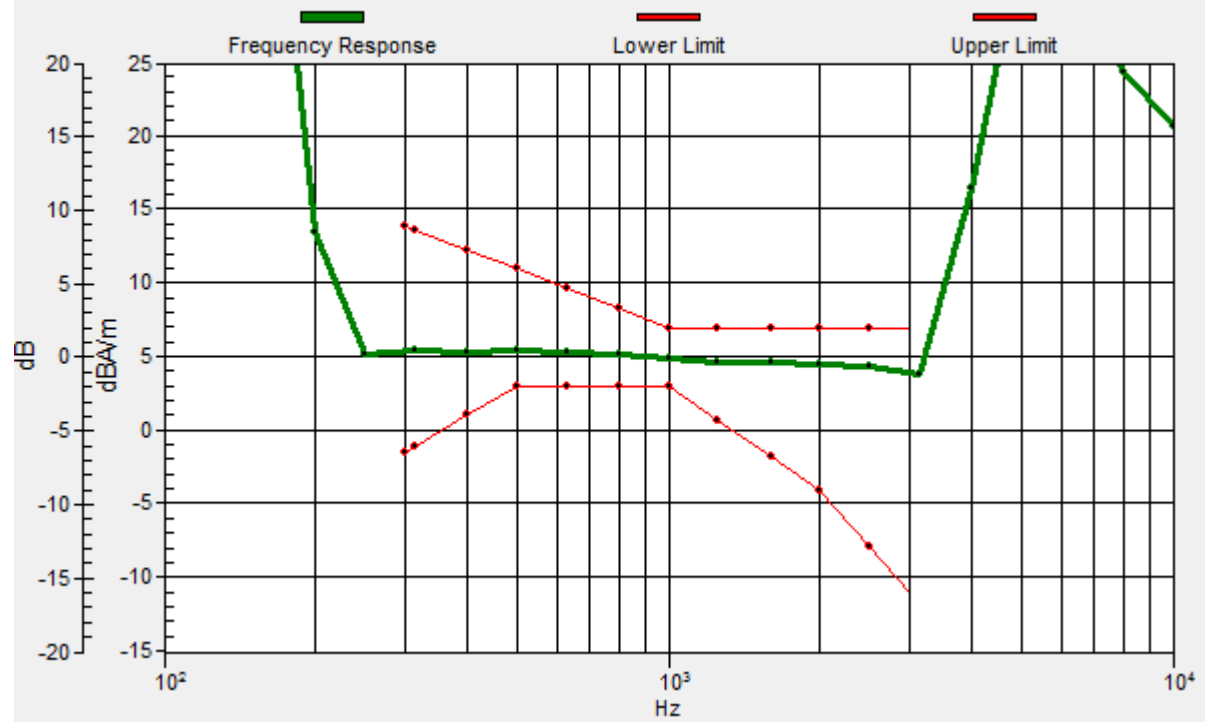
ABM1 comp = 5.39 dBA/m

Location: 0, -16.7, 3.7 mm



Ch9400/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 0, -16.7, 3.7 mm Diff: 2dB



5 HAC T-Coil WCDMA II_Voice_Ch9400(Y)_Battery 1

Communication System: UID 0, UMTS (0); Frequency: 1880 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

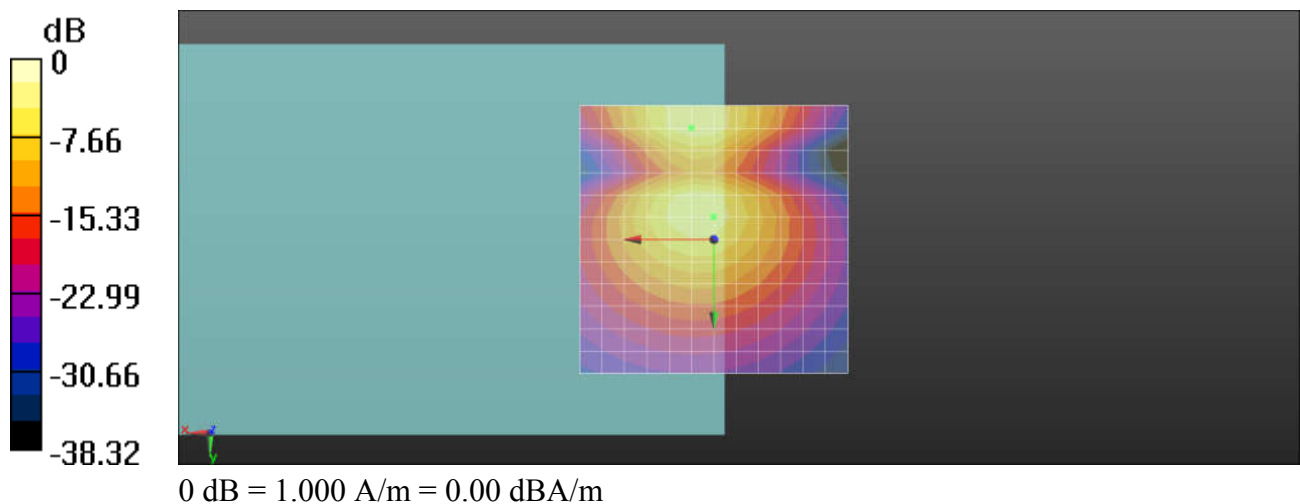
Ch9400/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 45.18 dB

ABM1 comp = -3.34 dBA/m

Location: 0, -4.2, 3.7 mm



6 HAC T-Coil GSM850_Voice_Ch189(Z)_Battery 2

Communication System: UID 0, General GSM (0); Frequency: 836.4 MHz; Duty Cycle: 1:8.3

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

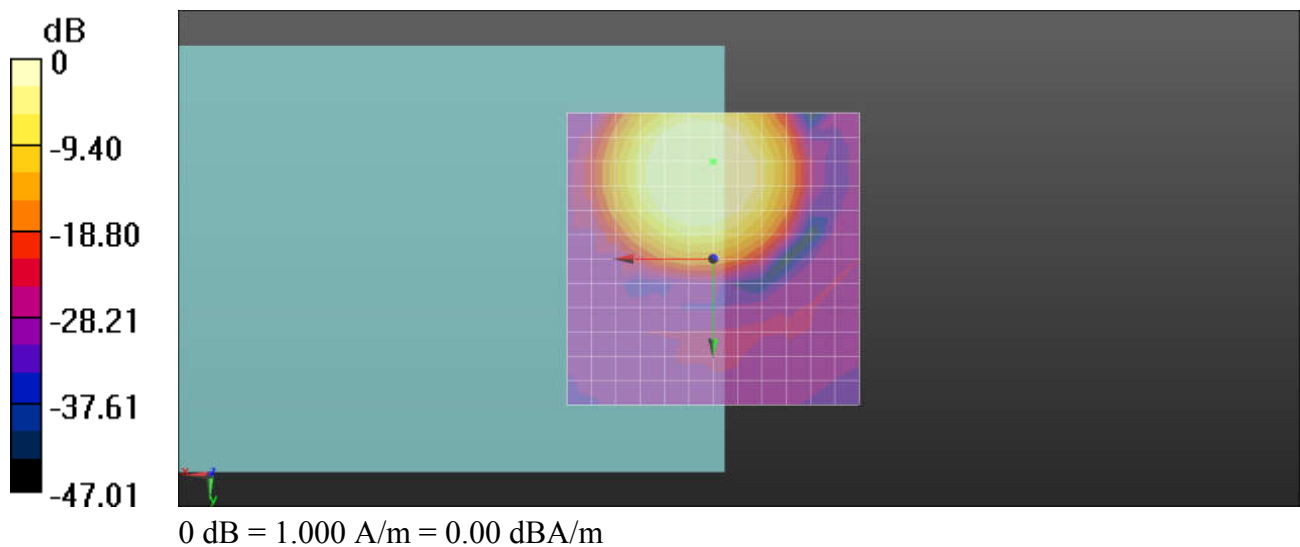
- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch189/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

ABM1/ABM2 = 35.88 dB

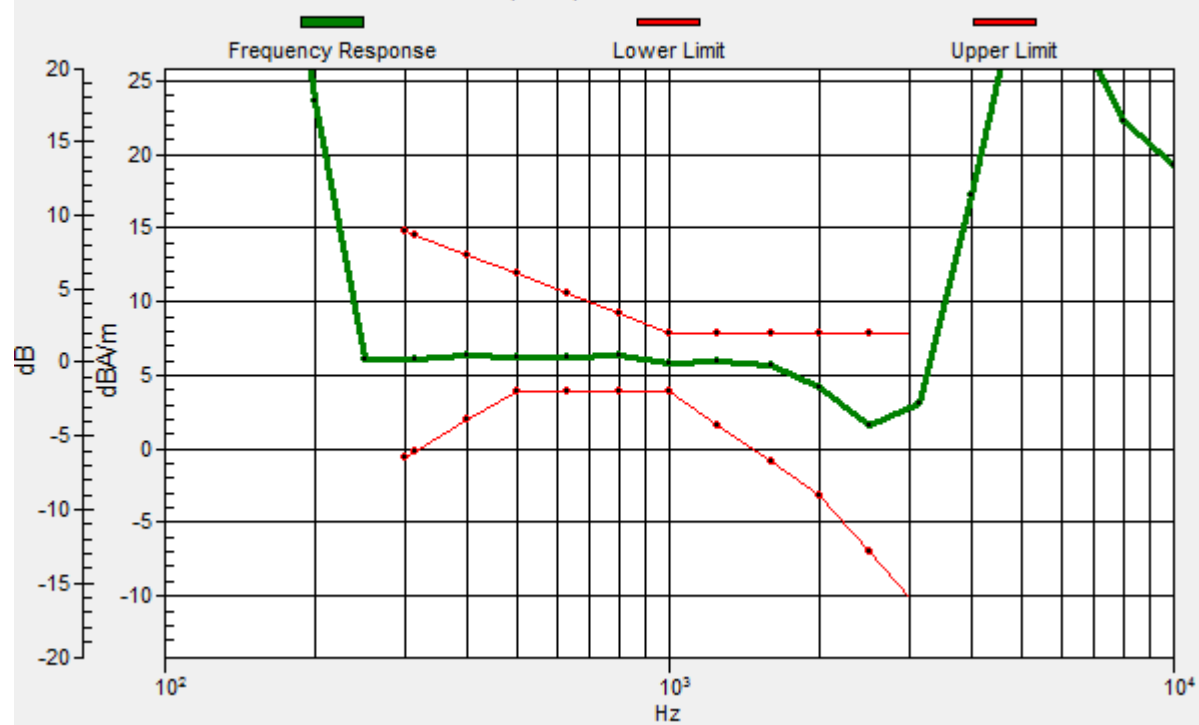
ABM1 comp = 5.81 dBA/m

Location: 0, -16.7, 3.7 mm



Ch189/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 0, -16.7, 3.7 mm Diff: 1.93dB



6 HAC T-Coil GSM850_Voice_Ch189(Y)_Battery 2

Communication System: UID 0, General GSM (0); Frequency: 836.4 MHz; Duty Cycle: 1:8.3

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

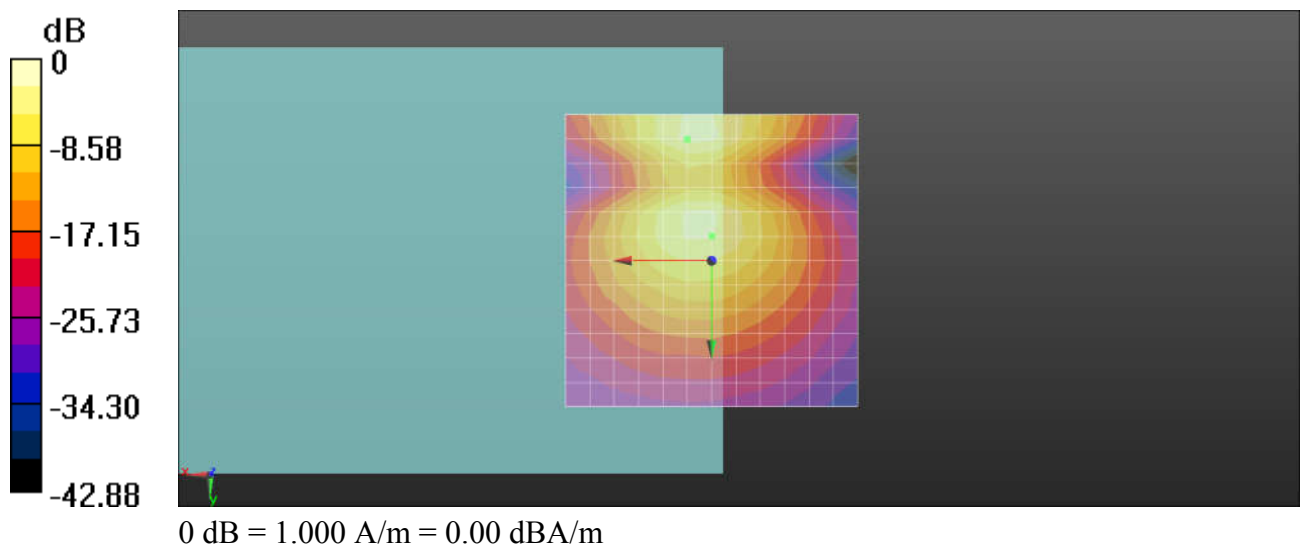
Ch189/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 41.62 dB

ABM1 comp = -2.51 dBA/m

Location: 0, -4.2, 3.7 mm



7 HAC T-Coil GSM1900_Voice_Ch661(Z)_Battery 2

Communication System: UID 0, General GSM (0); Frequency: 1880 MHz; Duty Cycle: 1:8.3

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

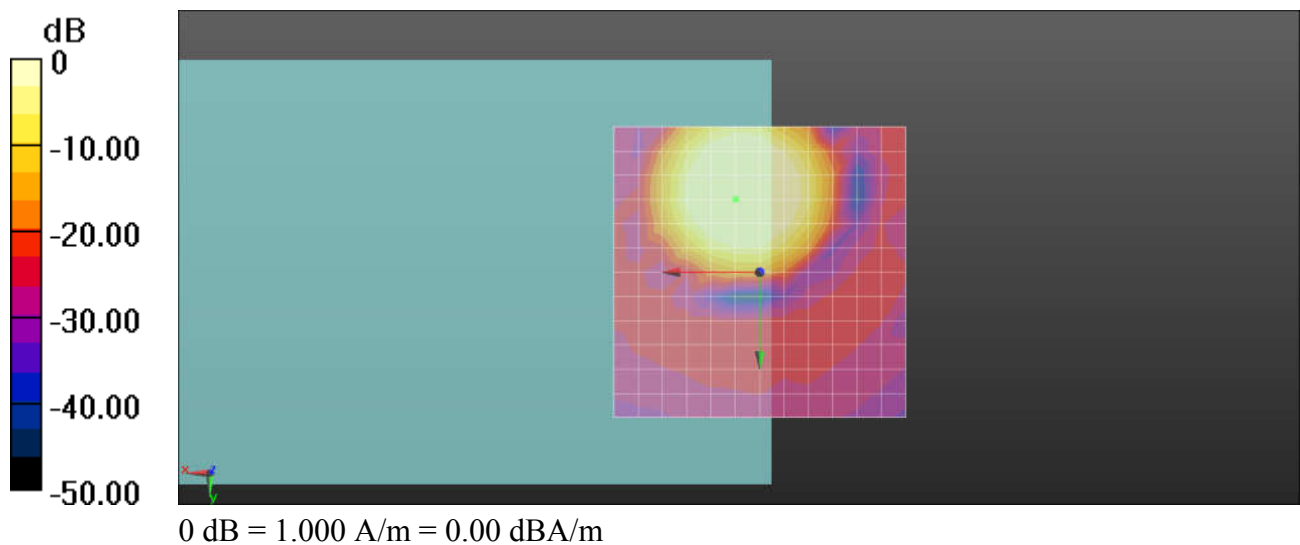
- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch661/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

ABM1/ABM2 = 42.19 dB

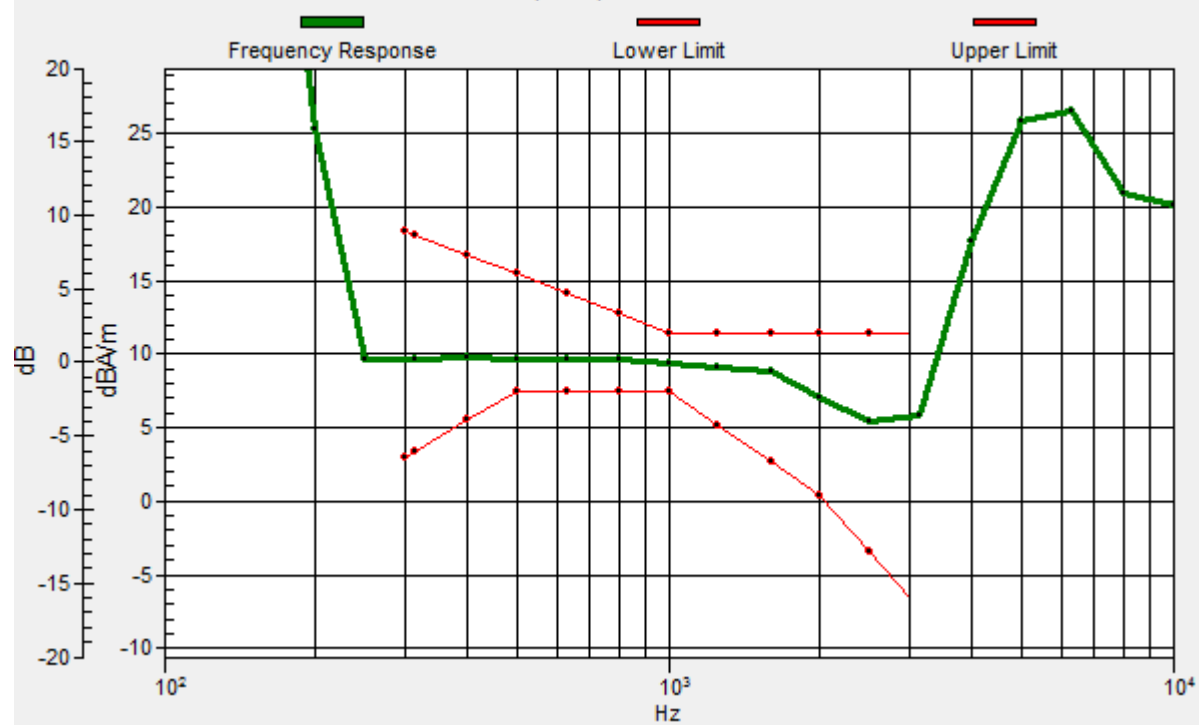
ABM1 comp = 9.10 dBA/m

Location: 4.2, -12.5, 3.7 mm



Ch661/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 4.2, -12.5, 3.7 mm Diff: 2dB



7 HAC T-Coil GSM1900_Voice_Ch661(Y)_Battery 2

Communication System: UID 0, General GSM (0); Frequency: 1880 MHz; Duty Cycle: 1:8.3

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

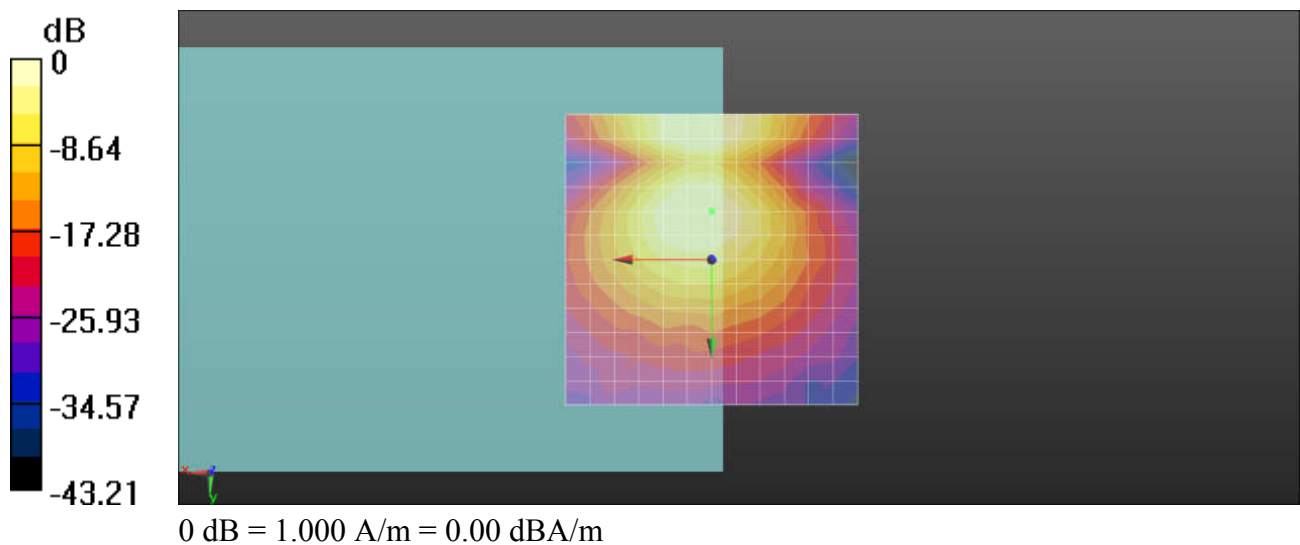
Ch661/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 47.76 dB

ABM1 comp = 2.22 dBA/m

Location: 0, -8.3, 3.7 mm



8 HAC T-Coil WCDMA V_Voice_Ch4182(Z)_Battery 2

Communication System: UID 0, UMTS (0); Frequency: 836.4 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

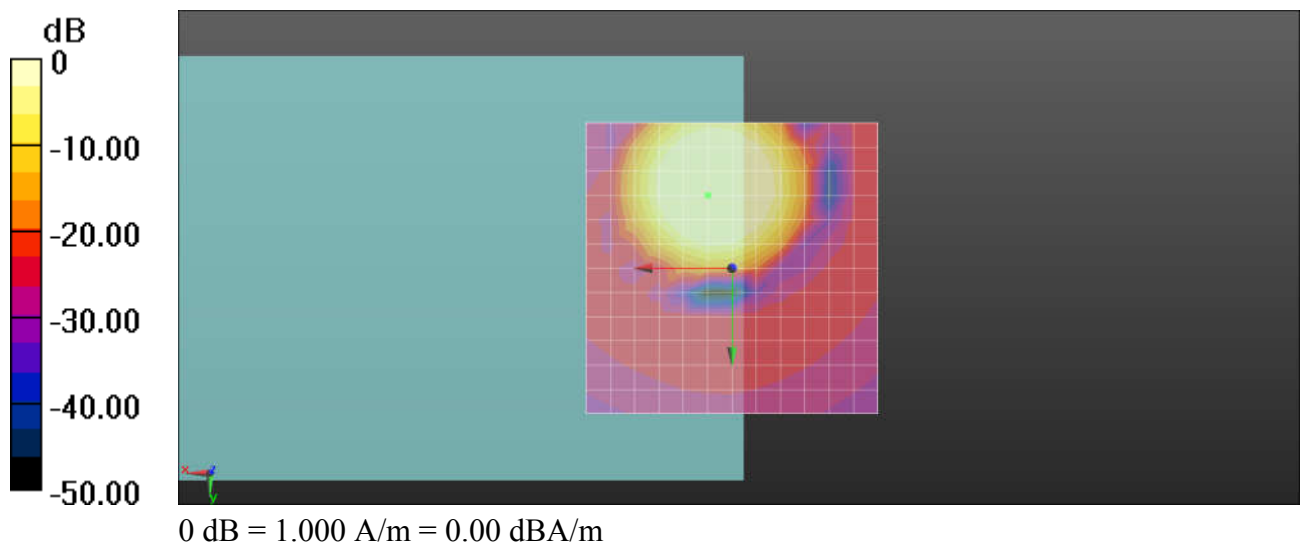
Ch4128/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 53.23 dB

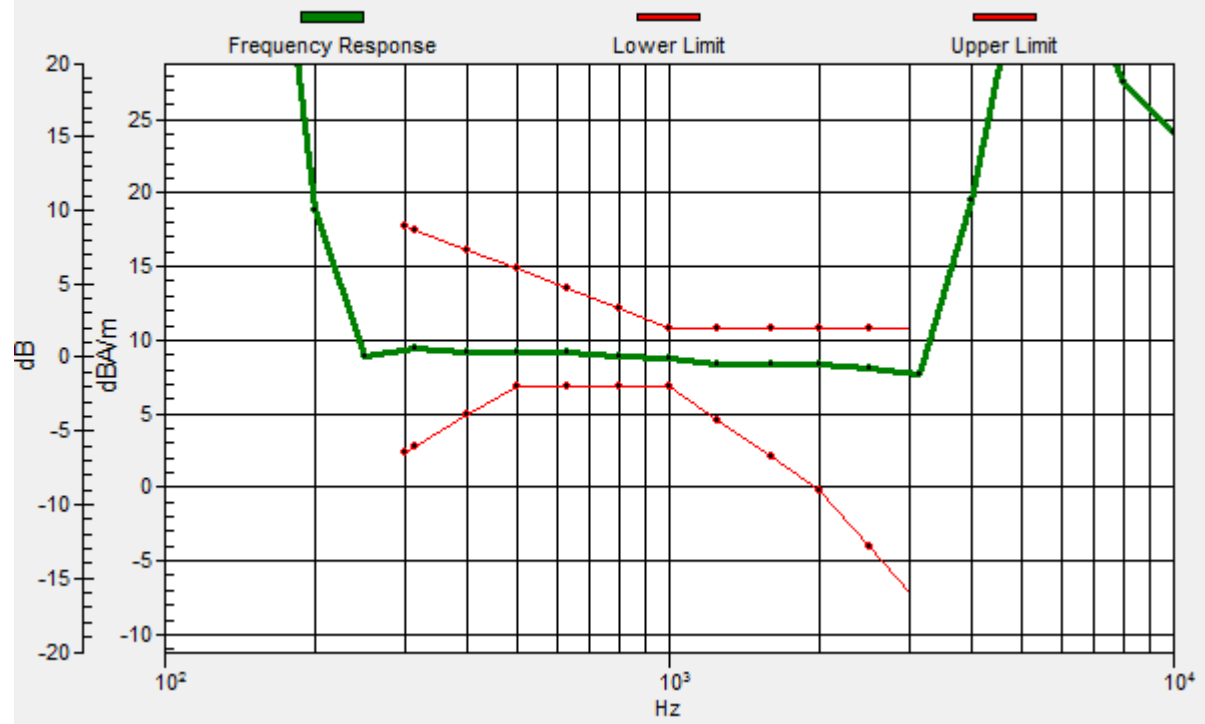
ABM1 comp = 9.47 dBA/m

Location: 4.2, -12.5, 3.7 mm



Ch4128/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 4.2, -12.5, 3.7 mm Diff: 2dB



8 HAC T-Coil WCDMA V_Voice_Ch4182(Y)_Battery 2

Communication System: UID 0, UMTS (0); Frequency: 836.4 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

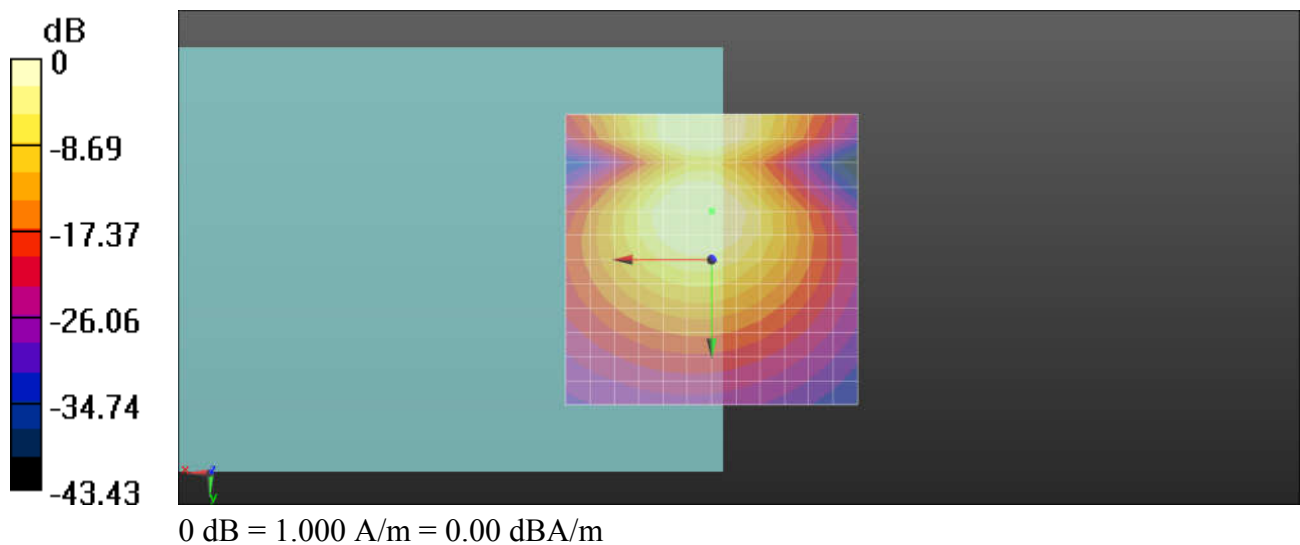
Ch4128/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 49.00 dB

ABM1 comp = 2.51 dBA/m

Location: 0, -8.3, 3.7 mm



9 HAC T-Coil WCDMA IV_Voice_Ch1413(Z)_Battery 2

Communication System: UID 0, UMTS (0); Frequency: 1732.6 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

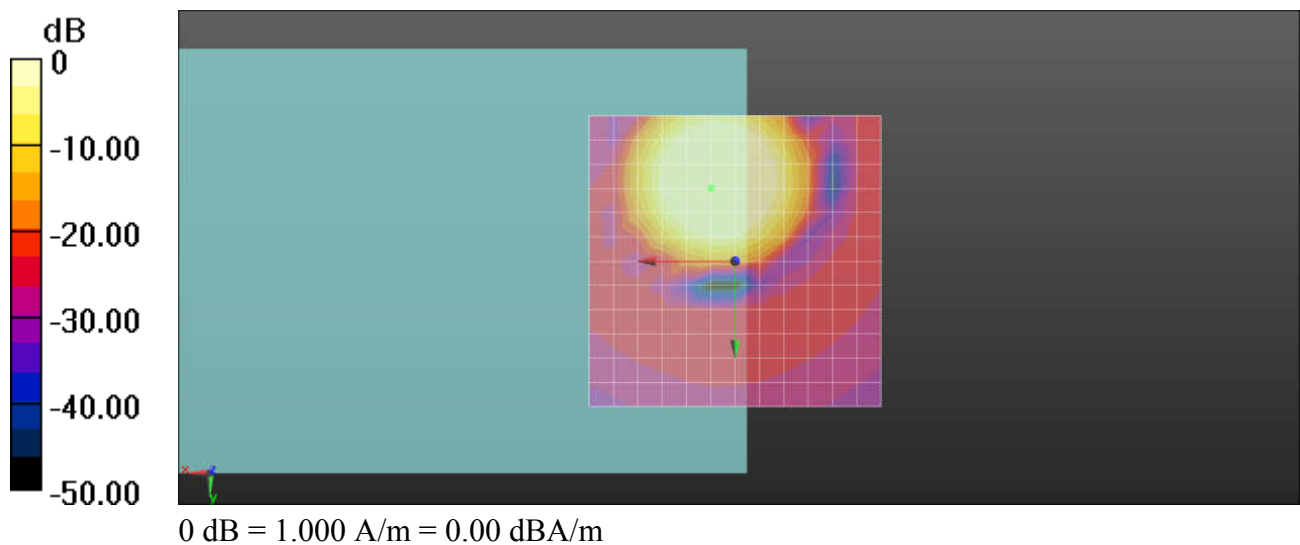
Ch1413/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 52.66 dB

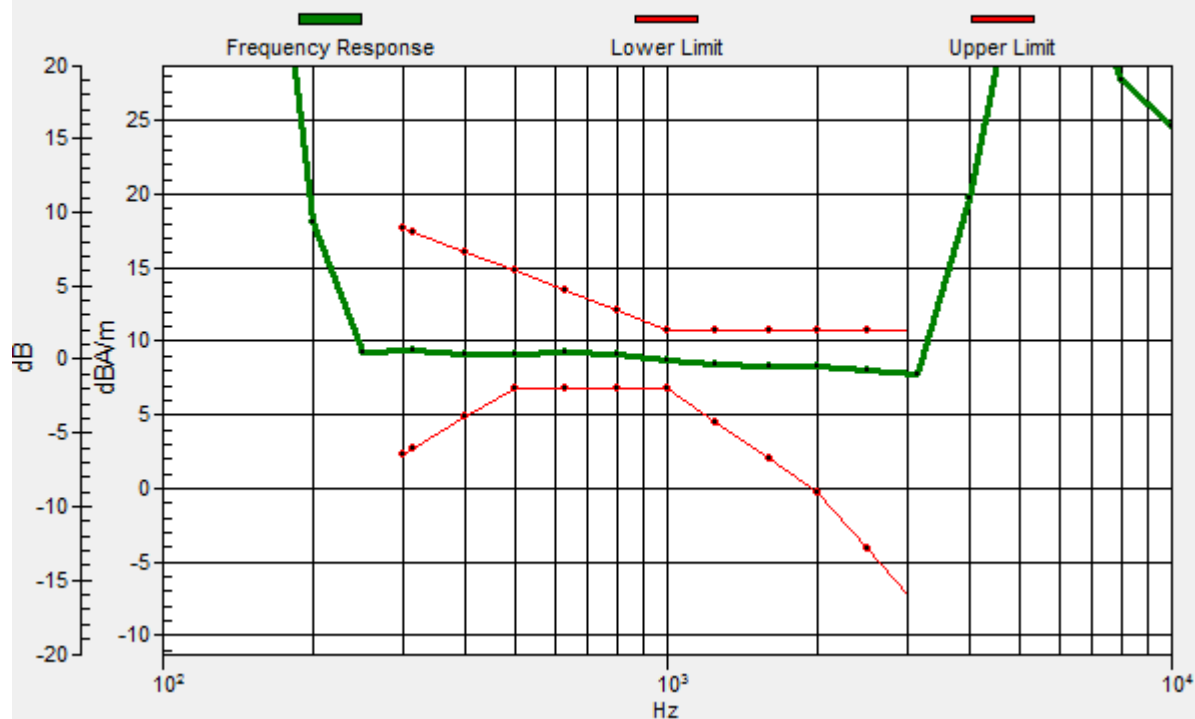
ABM1 comp = 9.40 dBA/m

Location: 4.2, -12.5, 3.7 mm



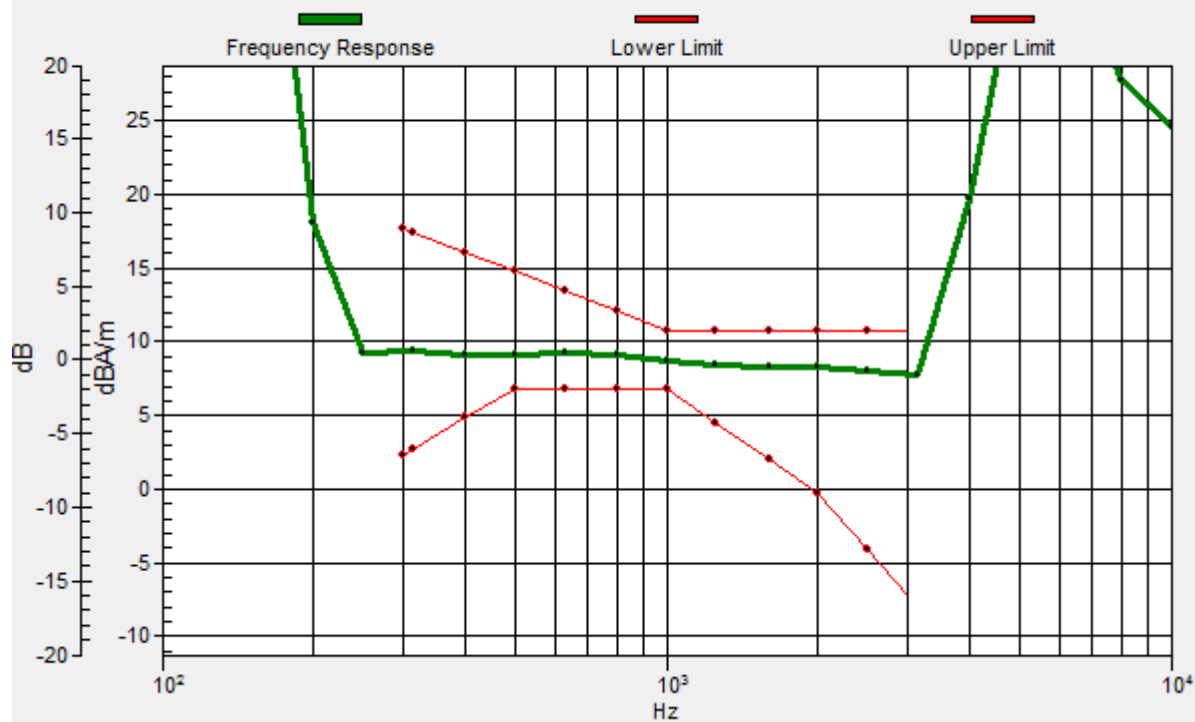
Ch1413/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 4.2, -12.5, 3.7 mm Diff: 2dB



Ch1413/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 4.2, -12.5, 3.7 mm Diff: 2dB



9 HAC T-Coil WCDMA IV_Voice_Ch1413(Y)_Battery 2

Communication System: UID 0, UMTS (0); Frequency: 1732.6 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

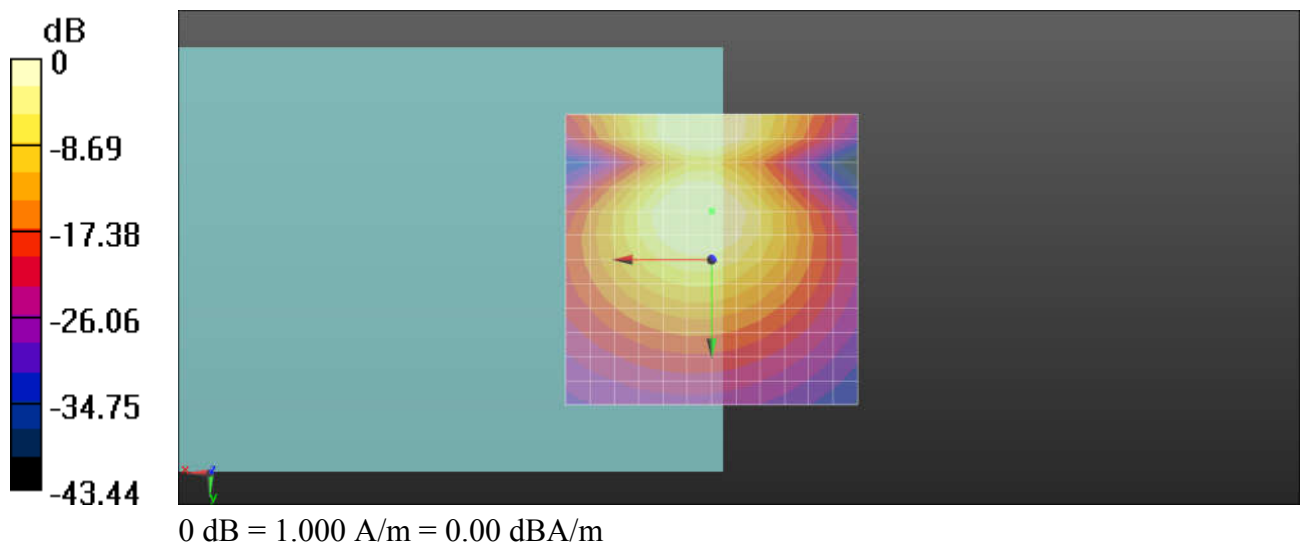
Ch1413/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 49.80 dB

ABM1 comp = 2.53 dBA/m

Location: 0, -8.3, 3.7 mm



10 HAC T-Coil WCDMA II_Voice_Ch9400(Z)_Battery 2

Communication System: UID 0, UMTS (0); Frequency: 1880 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

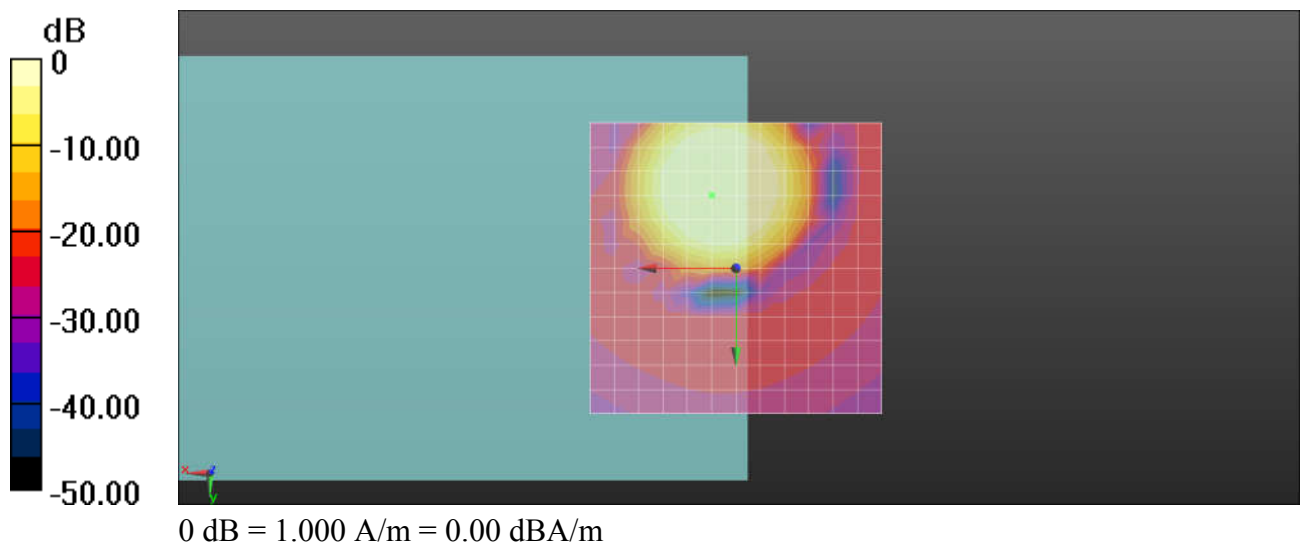
Ch9400/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 52.90 dB

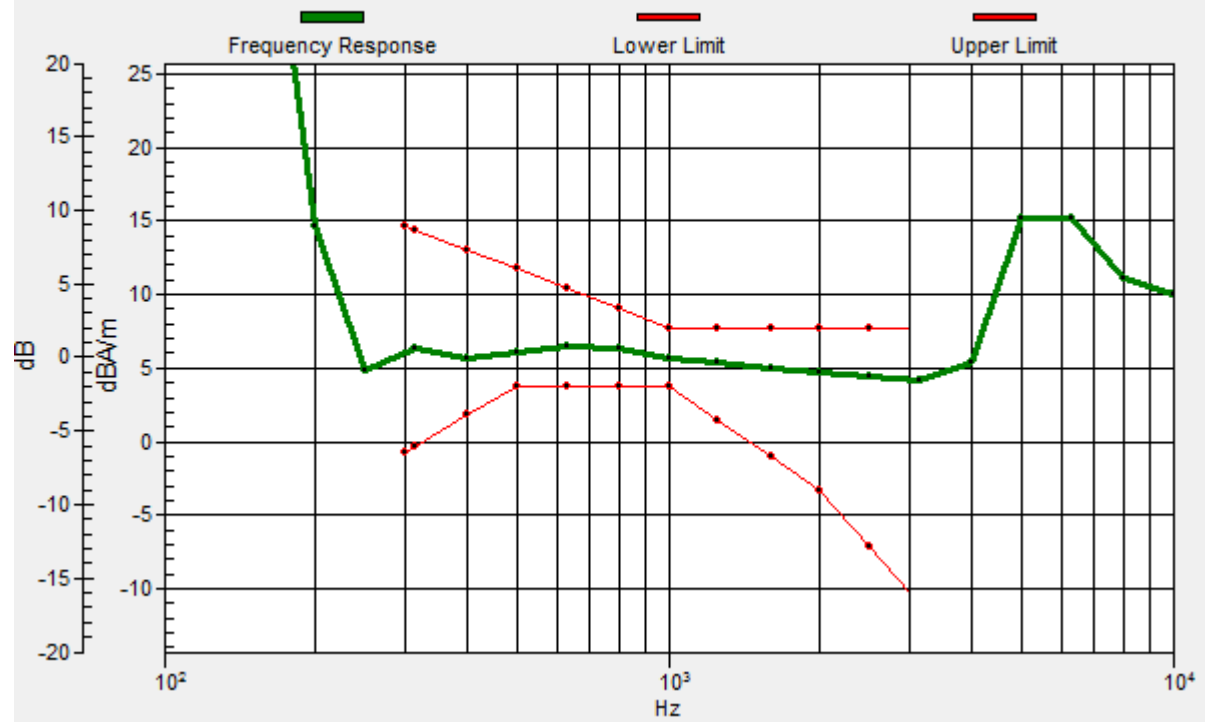
ABM1 comp = 9.45 dBA/m

Location: 4.2, -12.5, 3.7 mm



Ch9400/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 4.2, -12.5, 3.7 mm Diff: 2dB



10 HAC T-Coil WCDMA II_Voice_Ch9400(Y)_Battery 2

Communication System: UID 0, UMTS (0); Frequency: 1880 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

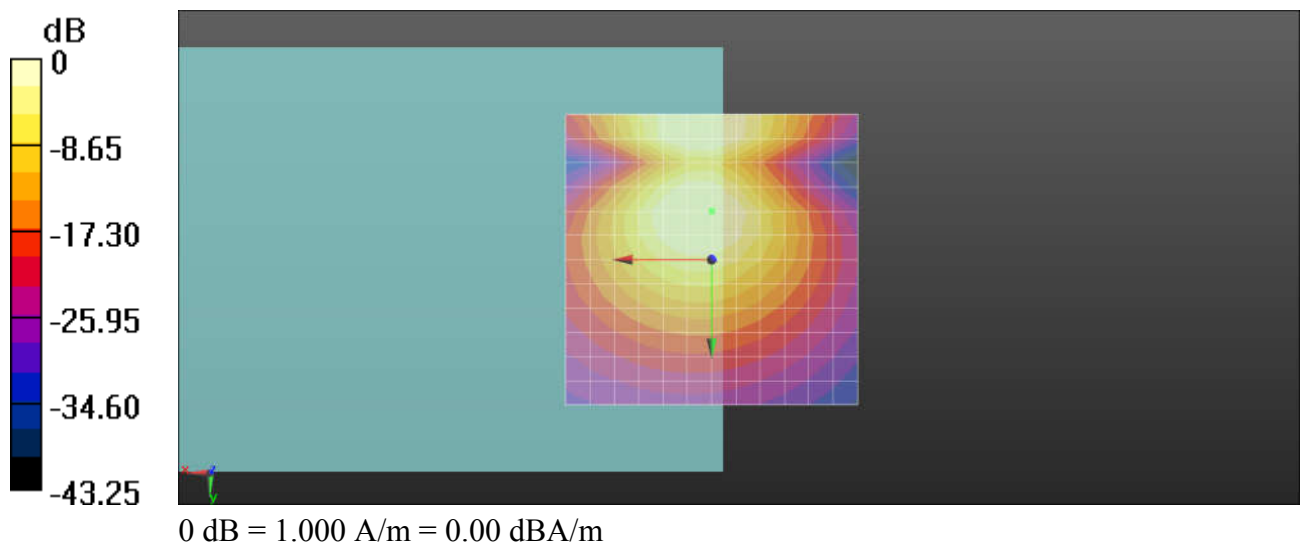
Ch9400/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 50.17 dB

ABM1 comp = 2.50 dBA/m

Location: 0, -8.3, 3.7 mm



11 HAC T-Coil GSM850_Voice_Ch189(Z)_Battery 1_Holster

Communication System: UID 0, General GSM (0); Frequency: 836.4 MHz; Duty Cycle: 1:8.3

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

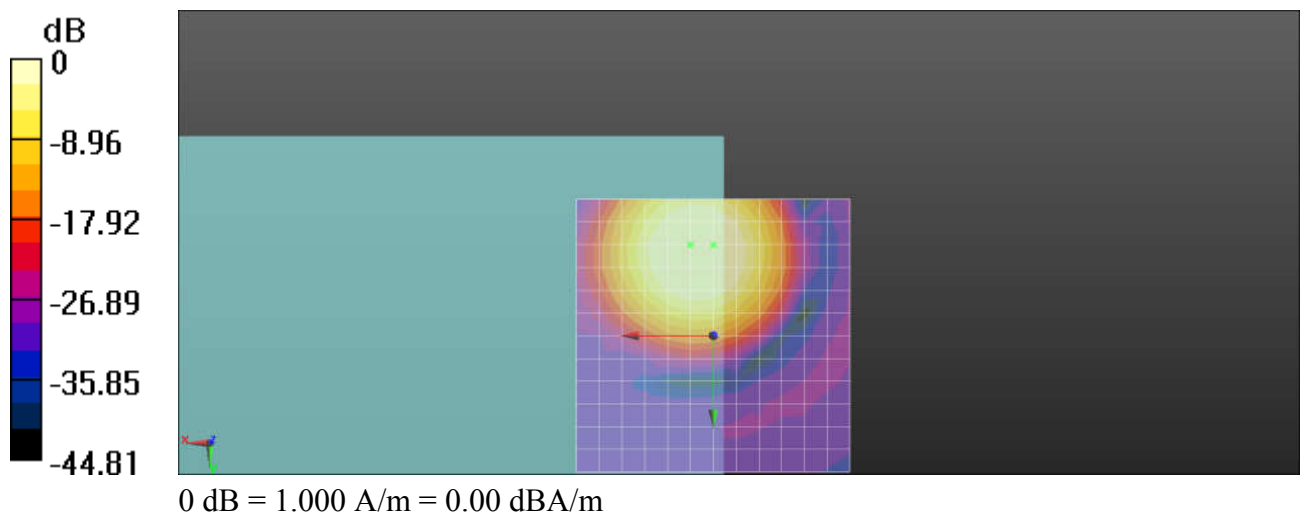
- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch189/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

ABM1/ABM2 = 33.18 dB

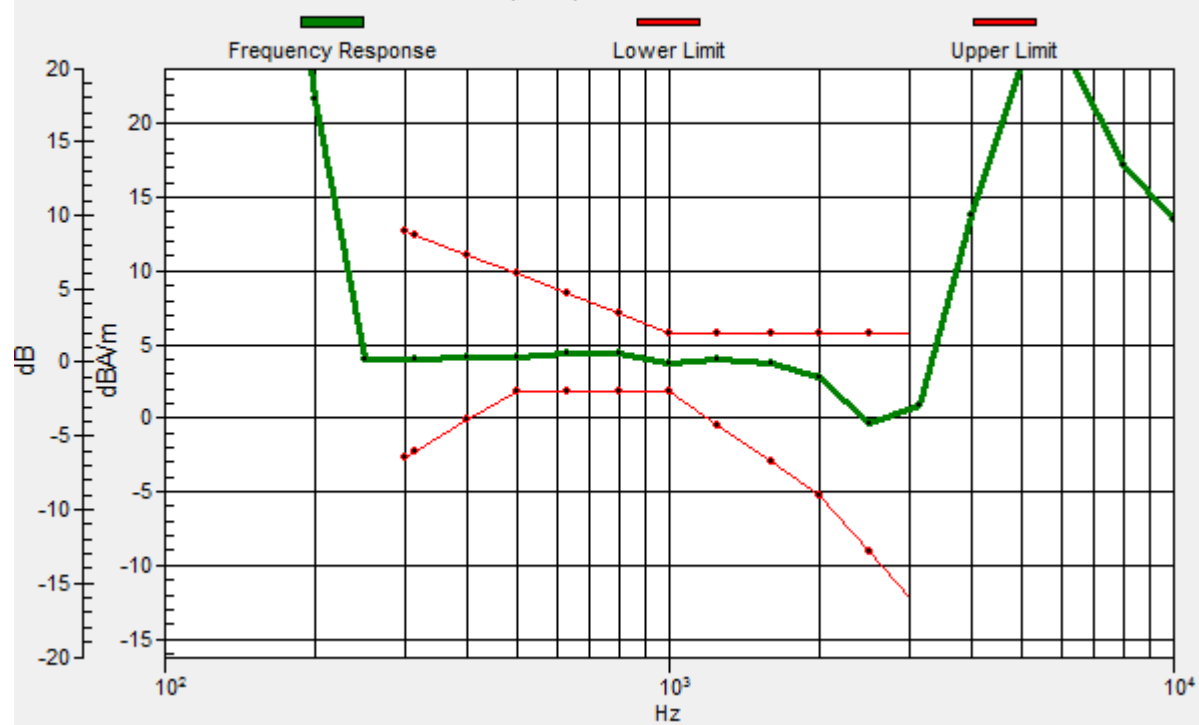
ABM1 comp = 3.59 dBA/m

Location: 0, -16.7, 3.7 mm



Ch189/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 0, -16.7, 3.7 mm Diff: 1.85dB



11 HAC T-Coil GSM850_Voice_Ch189(Y)_Battery 1_Holster

Communication System: UID 0, General GSM (0); Frequency: 836.4 MHz; Duty Cycle: 1:8.3

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3093; ; Calibrated: 2015.5.21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1210; Calibrated: 2015.5.21
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

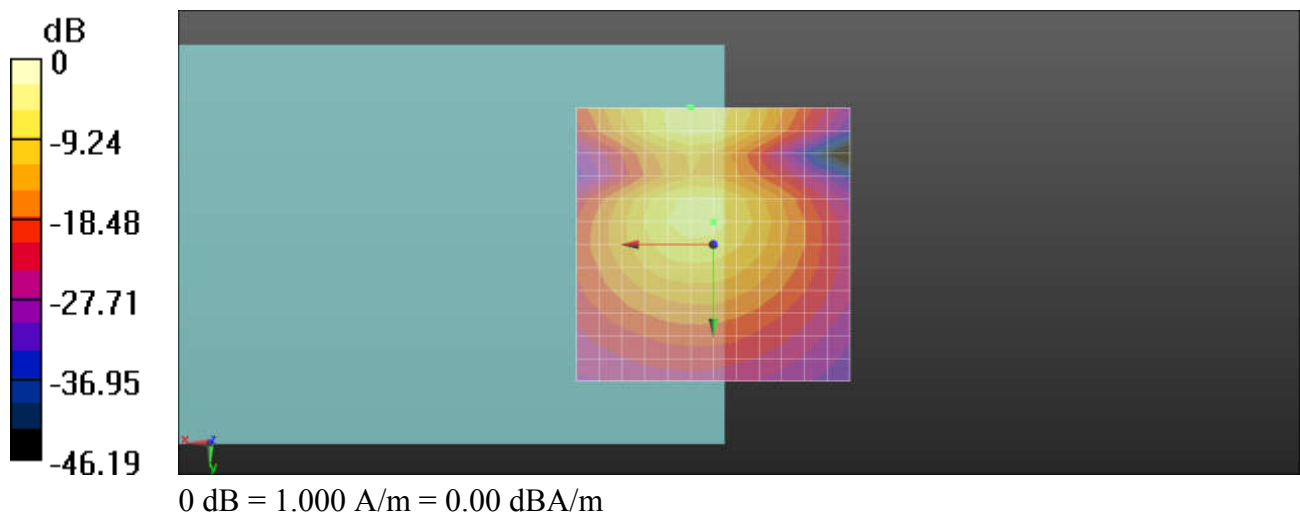
Ch189/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 38.61 dB

ABM1 comp = -5.00 dBA/m

Location: 0, -4.2, 3.7 mm



12 HAC T-Coil GSM1900_Voice_Ch661(Z)_Battery 1_Holster

Communication System: UID 0, General GSM (0); Frequency: 1880 MHz; Duty Cycle: 1:8.3

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

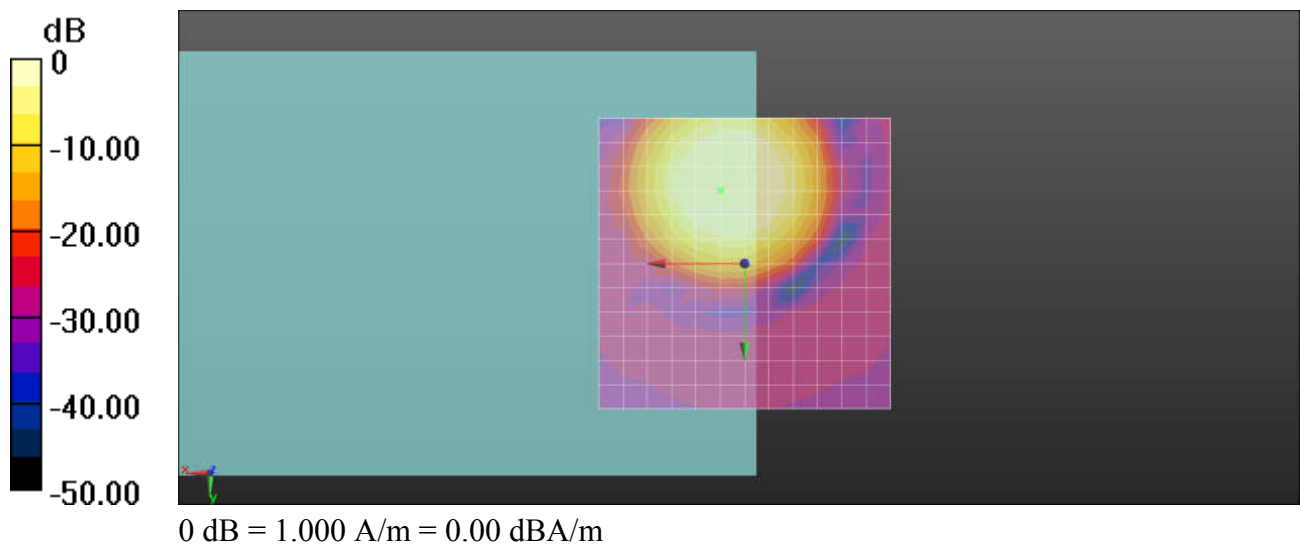
- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch661/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

ABM1/ABM2 = 40.24 dB

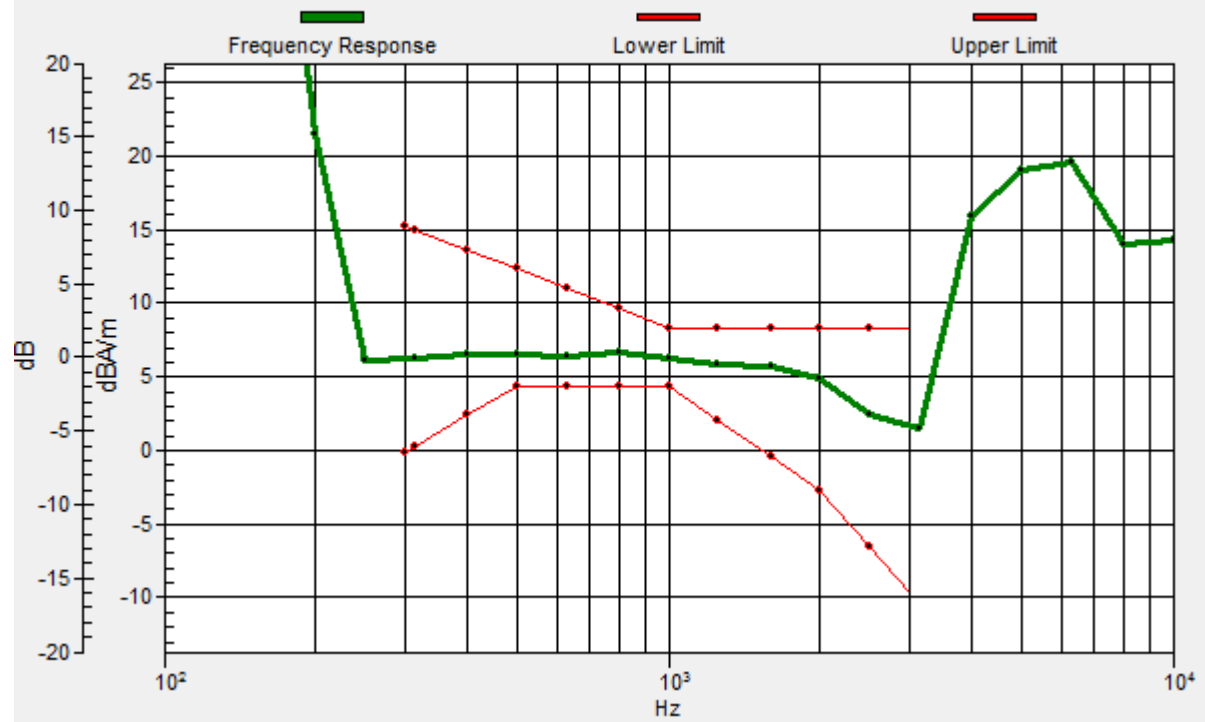
ABM1 comp = 6.14 dBA/m

Location: 4.2, -12.5, 3.7 mm



Ch661/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 4.2, -12.5, 3.7 mm Diff: 2dB



12 HAC T-Coil GSM1900_Voice_Ch661(Y)_Battery 1_Holster

Communication System: UID 0, General GSM (0); Frequency: 1880 MHz; Duty Cycle: 1:8.3

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

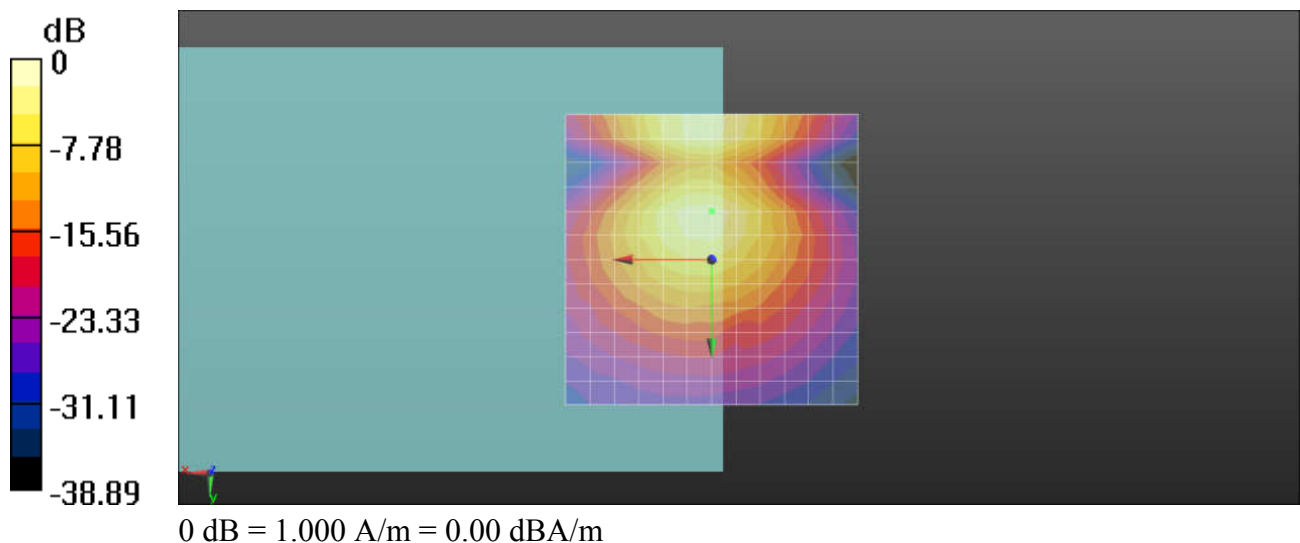
Ch661/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 44.01 dB

ABM1 comp = -0.80 dBA/m

Location: 0, -8.3, 3.7 mm



13 HAC T-Coil WCDMA V_Voice_Ch4182(Z)_Battery 1_Holster

Communication System: UID 0, UMTS (0); Frequency: 836.4 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

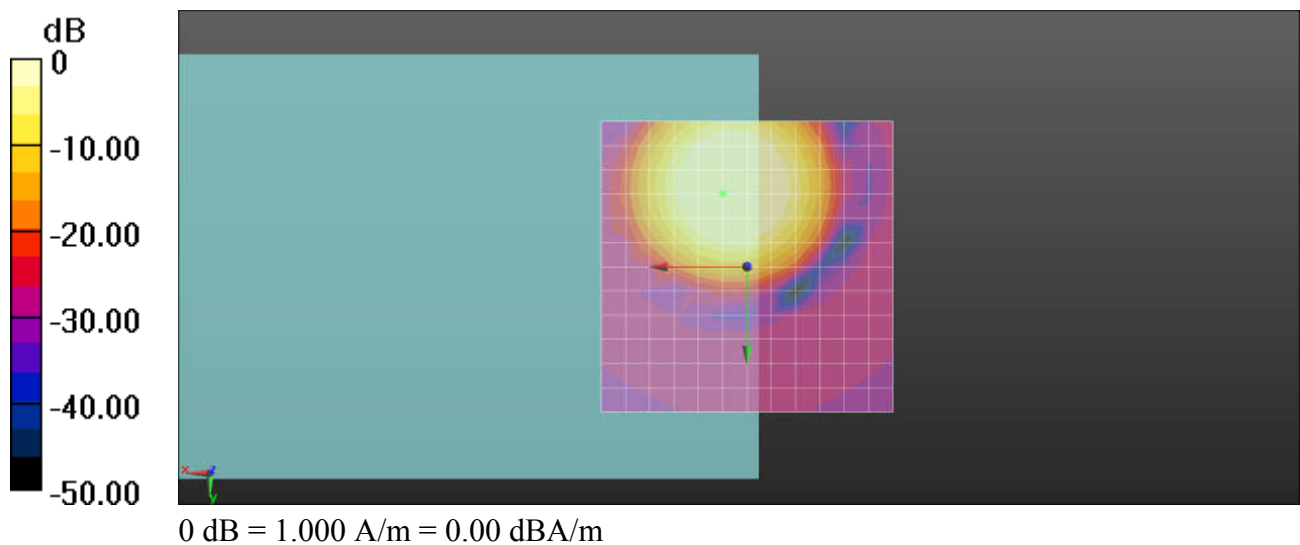
Ch4182/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 49.35 dB

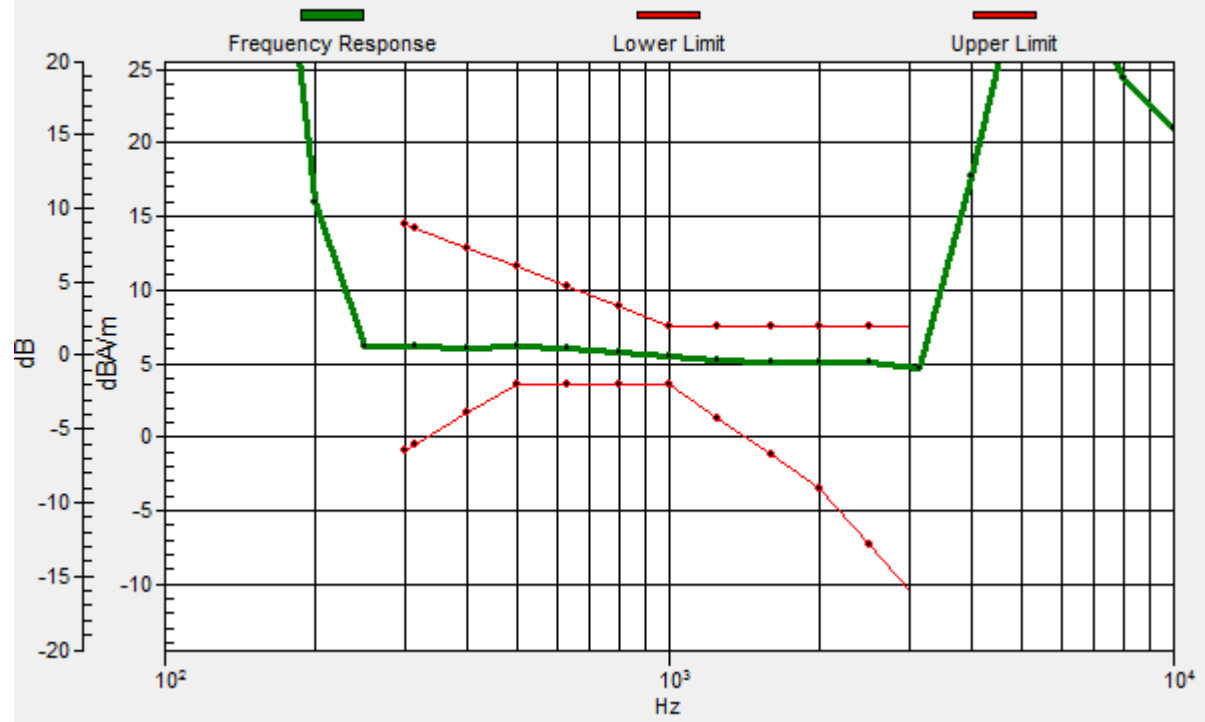
ABM1 comp = 6.32 dBA/m

Location: 4.2, -12.5, 3.7 mm



Ch4182/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 4.2, -12.5, 3.7 mm Diff: 2dB



13 HAC T-Coil WCDMA V_Voice_Ch4182(Y)_Battery 1_Holster

Communication System: UID 0, UMTS (0); Frequency: 836.4 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

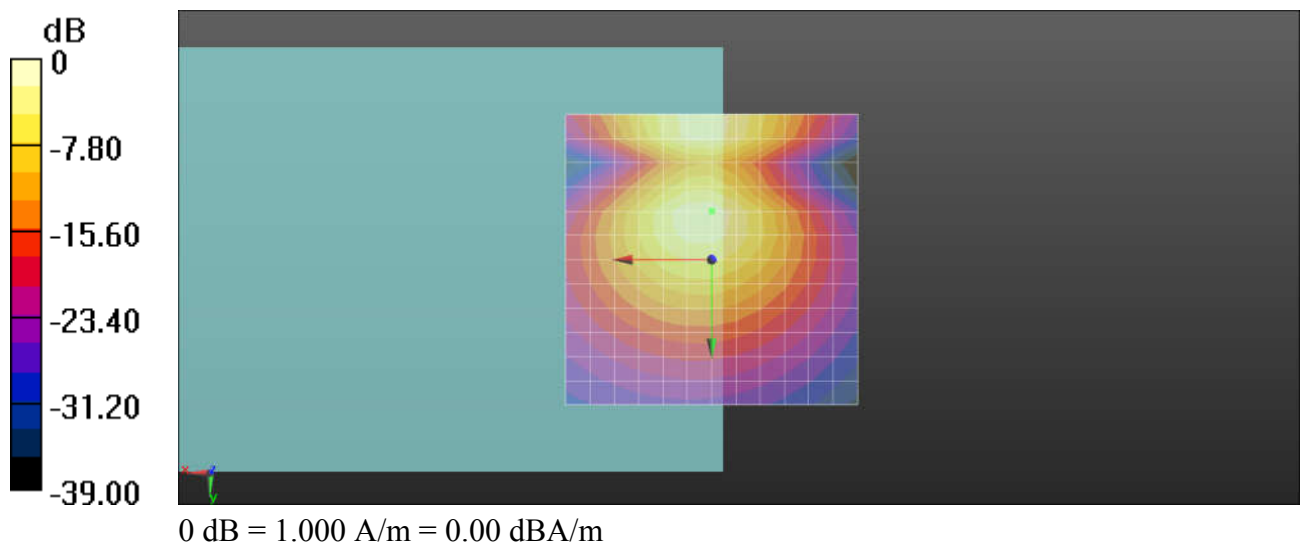
Ch4182/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 45.25 dB

ABM1 comp = -0.53 dBA/m

Location: 0, -8.3, 3.7 mm



14 HAC T-Coil WCDMA IV_Voice_Ch1413(Z)_Battery 1_Holster

Communication System: UID 0, UMTS (0); Frequency: 1732.6 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

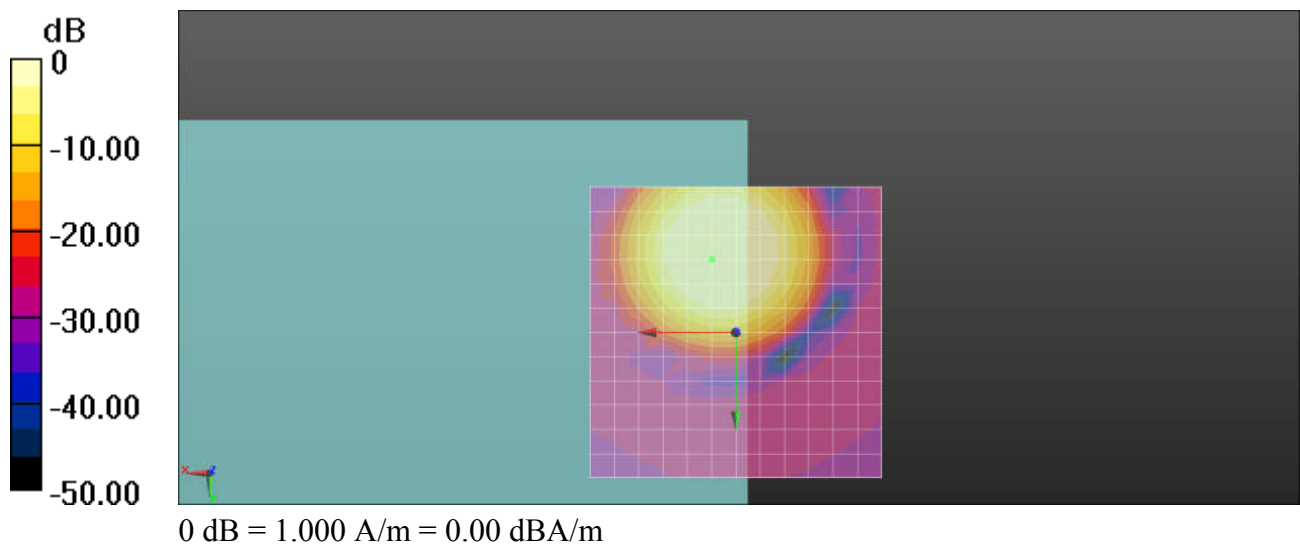
Ch1413/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 48.36 dB

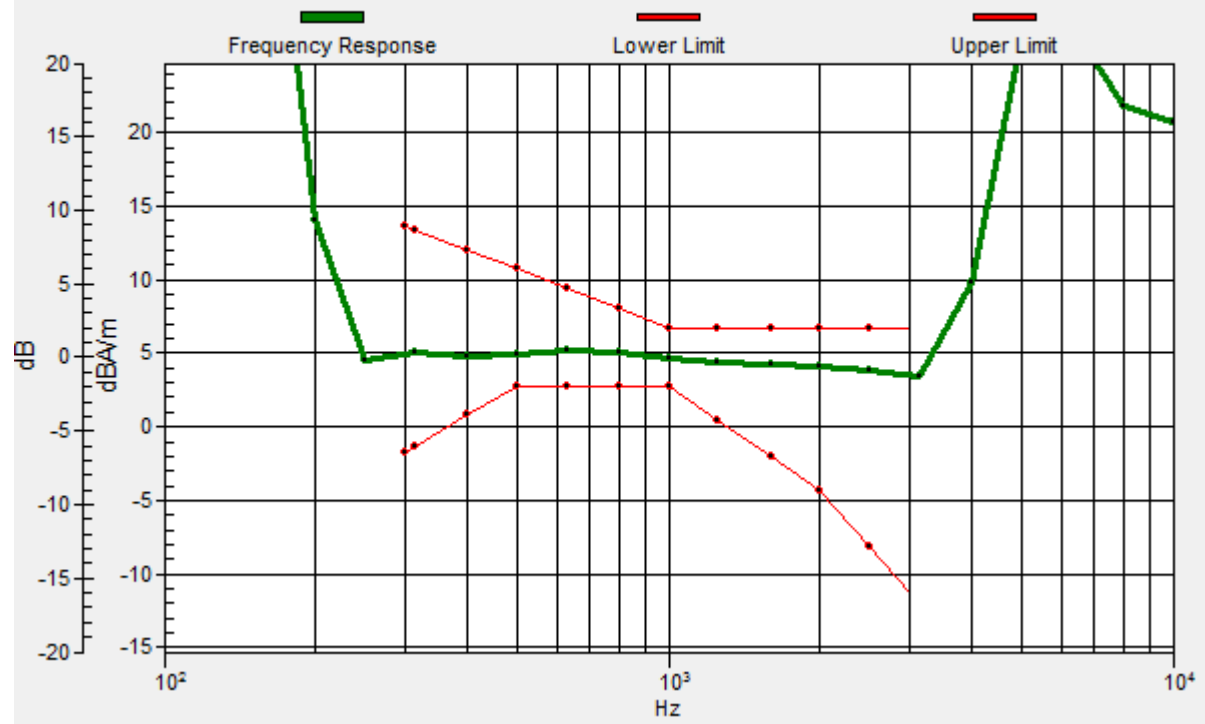
ABM1 comp = 6.16 dBA/m

Location: 4.2, -12.5, 3.7 mm



Ch1413/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 4.2, -12.5, 3.7 mm Diff: 2dB



14 HAC T-Coil WCDMA IV_Voice_Ch1413(Y)_Battery 1_Holster

Communication System: UID 0, UMTS (0); Frequency: 1732.6 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

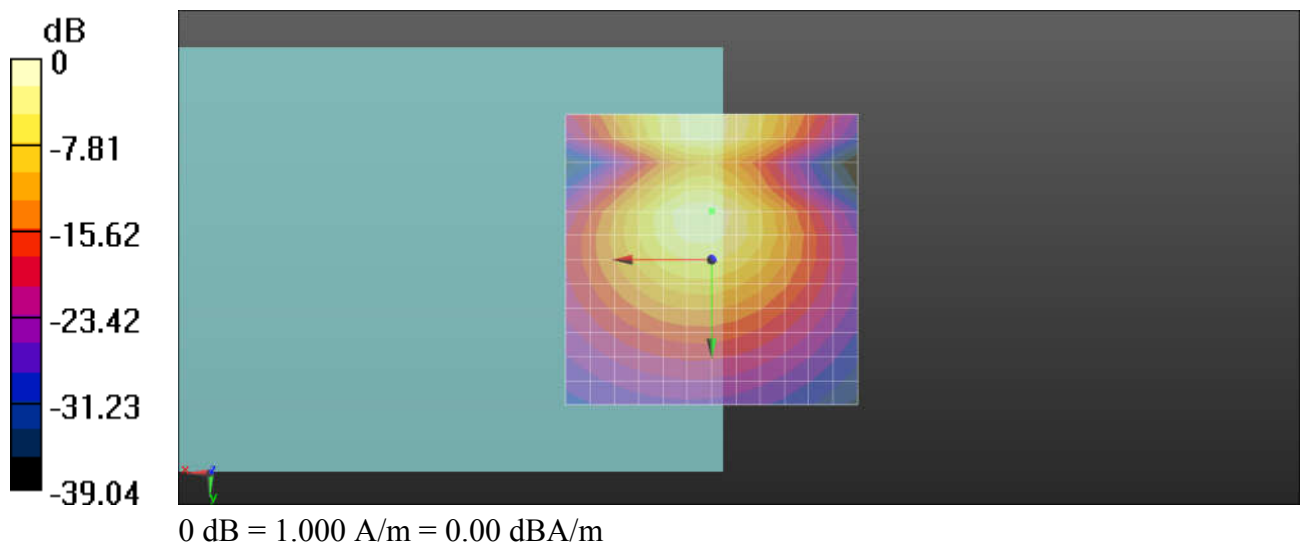
Ch1413/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:

dx=10mm, dy=10mm

ABM1/ABM2 = 44.86 dB

ABM1 comp = -0.60 dBA/m

Location: 0, -8.3, 3.7 mm



15 HAC T-Coil WCDMA II_Voice_Ch9400(Z)_Battery 1_Holster

Communication System: UID 0, UMTS (0); Frequency: 1880 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

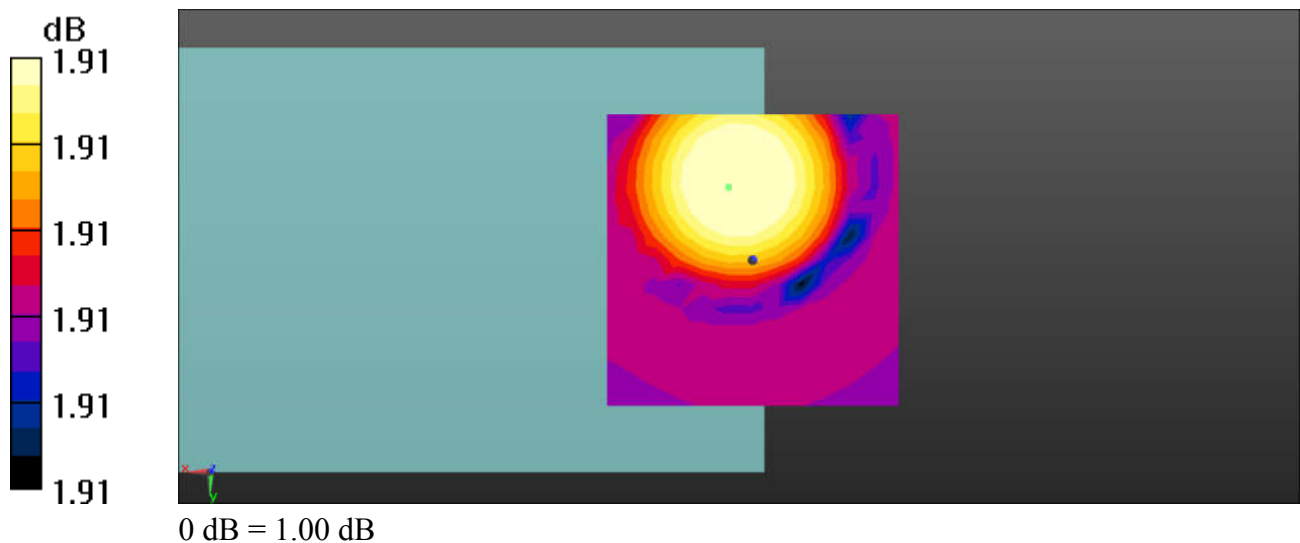
Ch9400/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:
dx=10mm, dy=10mm

Cursor:

ABM1/ABM2 = 47.73 dB

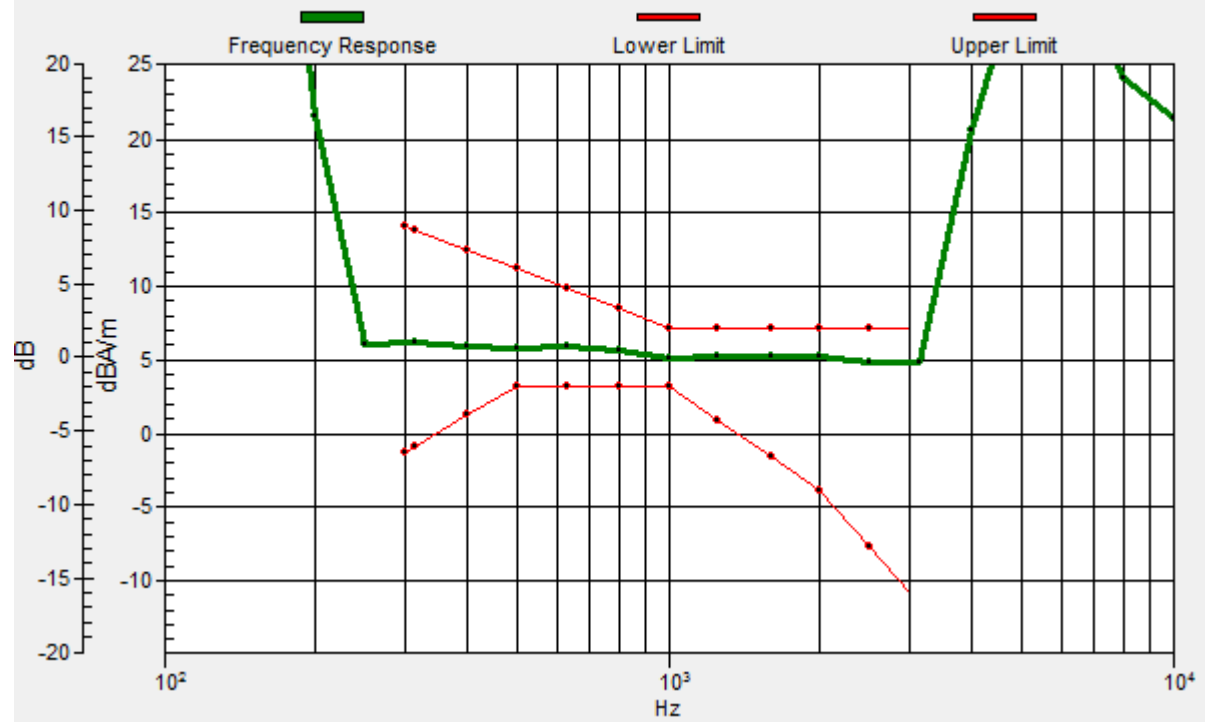
ABM1 comp = 6.14 dBA/m

Location: 4.2, -12.5, 3.7 mm



Ch9400/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)

Loc: 4.2, -12.5, 3.7 mm Diff: 1.91dB



15 HAC T-Coil WCDMA II_Voice_Ch9400(Y)_Battery 1_Holster

Communication System: UID 0, UMTS (0); Frequency: 1880 MHz; Duty Cycle: 1:1

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

Ambient Temperature : 23.6 °C

DASY5 Configuration:

- Probe: AM1DV3 - 3128; ; Calibrated: 2016.1.12
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn917; Calibrated: 2015.12.14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch9400/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid:
dx=10mm, dy=10mm

Cursor:

ABM1/ABM2 = 45.28 dB

ABM1 comp = -0.60 dBA/m

Location: 0, -8.3, 3.7 mm

