HAC TEST REPORT

Applicant	Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd
FCC ID	R38YL3310A
Product	Smartphone
Model	Coolpad 3310A
Report No.	R1805A0223-H2
Issue Date	June 13, 2018

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **ANSI C63.19-2011**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Performed by: Jiangpeng Lan *Approved by: Kai Xu*

TA Technology (Shanghai) Co., Ltd.

No.145, Jintang Rd, Tangzhen Industry Park, Pudong Shanghai, China
TEL: +86-021-50791141/2/3
FAX: +86-021-50791141/2/3-8000

Table of Contents

1 Test Laboratory

1.1 Notes of the Test Report

This report shall not be reproduced in full or partial, without the written approval of **TA technology (shanghai) co., Ltd).**The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein .Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

1.2 Test facility

CNAS (accreditation number: L2264)

TA Technology (Shanghai) Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS).

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

IC (recognition number is 8510A)

TA Technology (Shanghai) Co., Ltd. has been listed by industry Canada to perform electromagnetic emission measurement.

VCCI (recognition number is C-4595, T-2154, R-4113, G-10766)

TA Technology (Shanghai) Co., Ltd. has been listed by industry Japan to perform electromagnetic emission measurement.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

1.3 Testing Location

Company: TA Technology (Shanghai) Co., Ltd.

Address: No.145, Jintang Rd, Tangzhen Industry Park, Pudong Shanghai, China

City: Shanghai

Post code: 201201

Country: P. R. China

Contact: Xu Kai

Telephone: +86-021-50791141/2/3

Fax: +86-021-50791141/2/3-8000

Website: http://www.ta-shanghai.com

E-mail: xukai@ta-shanghai.com

1.4 Laboratory Environment

Temperature	Min. = 18°C, Max. = 28 °C
Relative humidity	Min. = 0%, Max. = 80%
Ground system resistance	< 0.5 Ω
Ambient noise is checked and found very low and in compliance with requirement of standards. Reflection of surrounding objects is minimized and in compliance with requirement of standards.	

2 Statement of Compliance

Table 2.1: T-Coil signal quality categories of each tested Mode

Band	Category
CDMA BC0	T4
CDMA BC1	T4
CDMA BC10	T4
LTE Band 2	T3
LTE Band 4	T3
LTE Band 5	T3
LTE Band 12	T3
LTE Band 13	T3
LTE Band 25	T3
LTE Band 26	T3
LTE Band 41	T3
Date of Testing: May 20, 2018 and June 12, 2018	

3 Description of Equipment under Test

Client Information

Applicant	Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd
Applicant address	Coolpad Information Harbor, High-tech Industrial Park (North), Nanshan District, Shenzhen, P.R.C.
Manufacturer	Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd
Manufacturer address	Coolpad Information Harbor, High-tech Industrial Park (North), Nanshan District, Shenzhen, P.R.C.

General Technologies

Device Type	Portable Device	
EUT Stage	Production Unit	
Model	Coolpad 3310A	
IMEI	990007950008513	
Hardware Version	P0	
Software Version	3310A.SPRINT.180608.00	
Antenna Type	Internal Antenna	
Power Class:	CDMA BC0/BC1/BC10: 3 LTE FDD 2/4/5/12/13/25/26:3 LTE TDD 41:3	
Power Level	CDMA BC0/BC1/BC10: Tested with Power Control All up bits LTE FDD 2/4/5/12/13/25/26: max power LTE TDD 41: max power	
Test Modulation:	(CDMA) QPSK;; (LTE) QPSK, 16QAM;	
Operating Frequency Range(s):	**Mode**	**Tx (MHz)**
	CDMA BC0	824 ~ 849
	CDMA BC1	1850 ~ 1910
	CDMA BC10	817 ~ 824
	LTE FDD 2	1850 ~ 1910
	LTE FDD 4	1710 ~ 1755
	LTE FDD 5	824 ~ 849
	LTE FDD 12	699 ~ 716
	LTE FDD 13	777 ~ 787
	LTE FDD 25	1850~ 1915
	LTE FDD 26	814 ~ 849
	LTE TDD 41	2496 ~ 2690
Accessory Equipment		
Battery	Manufacturer: SHENZHEN RUIDE ELECTRONIC INDUSTRIAL CO.,LTD Model: CPLD-189	

Air-Interface	Band (MHz)	Type	HAC tested	Simultaneous Transmissions	Name of Voice Service	Power Reduction
CDMA	BC0	VO	Yes	Wi-Fi or BT	NA	No
	BC1	VO				No
	BC10	VO				No
LTE	FDD 2	VD	Yes	Wi-Fi or BT	VoLTE*	No
	FDD 4	VD				No
	FDD 5	VD				No
	FDD 12	VD				No
	FDD 13	VD				No
	FDD 25	VD				No
	FDD 26	VD				No
	TDD 41	VD				No
Wi-Fi	2450	DT	NA	CDMA, LTE	NA	No
Bluetooth (BT)	2440	DT	NA	CDMA, LTE	NA	No

VO= legacy Cellular Voice Service from Table 7.1 in 7.4.2.1 of ANSI C63.19-2011

DT= Digital Transport only (no voice)

VD= IP Voice Service over Digital Transport

Remark:

1. * Ref Lev in accordance with 7.4.2.1 of ANSI C63.19-2011 and the July 2012 VoLTE interpretation
2. This device has no VOIP function for WLAN.

4 Test Specification and Operational Conditions

4.1 Test Specification

The tests documented in this report were performed in accordance with the following:

FCC CFR47 Part 20.19
ANSI C63.19-2011
285076 D01 HAC Guidance v05
285076 D02 T-Coil Testing v03

5 Test Information

5.1 Operational Conditions during Test

5.1.1 General Description of Test Procedures

The phone was tested in all normal configurations for the ear use. The EUT is mounted in the device holder equivalent as for classic dosimeter measurements. The acoustic output of the EUT shall coincide with the center point of the area formed by the dielectric wire and the middle bar of the arch's top frame The EUT shall be moved vertically upwards until it touches the frame. The fine adjustment is possible by sliding the complete. EUT holder on the yellow base plate of the Test Arch phantom. During the test, the EUT is selected on T-Coil mode, the LCD backlight is turn off and volume is adjusted to maximum level.

A communication link is set up with a System Simulator (SS) by RF cable, and a call is established. The Absolute Radio Frequency Channel Number (ARFCN) is allocated to Ch Middle respectively in the case of Band. T-Coil configurations is measured using System Simulator (SS) of CMU200/ CMW 500, at the same time the EUT shall be operated at its maximum RF output power setting.

5.2 T-Coil Measurements System Configuration

5.2.1 T-coil Measurement Set-up

These measurements are performed using the DASY5 automated dosimetric assessment system. It is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland. It consists of high precision robotics system (Stäubli), robot controller, Intel Core computer, near-field probe, probe alignment sensor. The robot is a six-axis industrial robot performing precise movements. Cell controller systems contain the power supply, robot controller, teach pendant (Joystick) and remote control, and are used to drive the robot motors. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification; signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

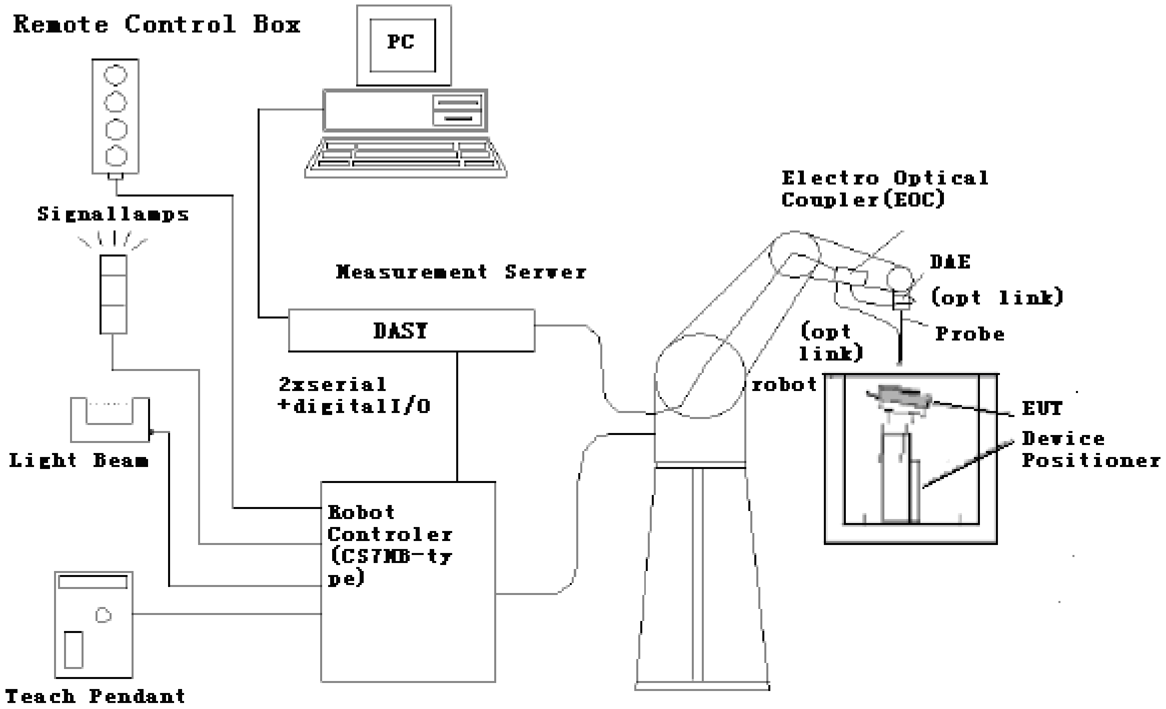


Figure 1 T-Coil Test Measurement Set-up

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

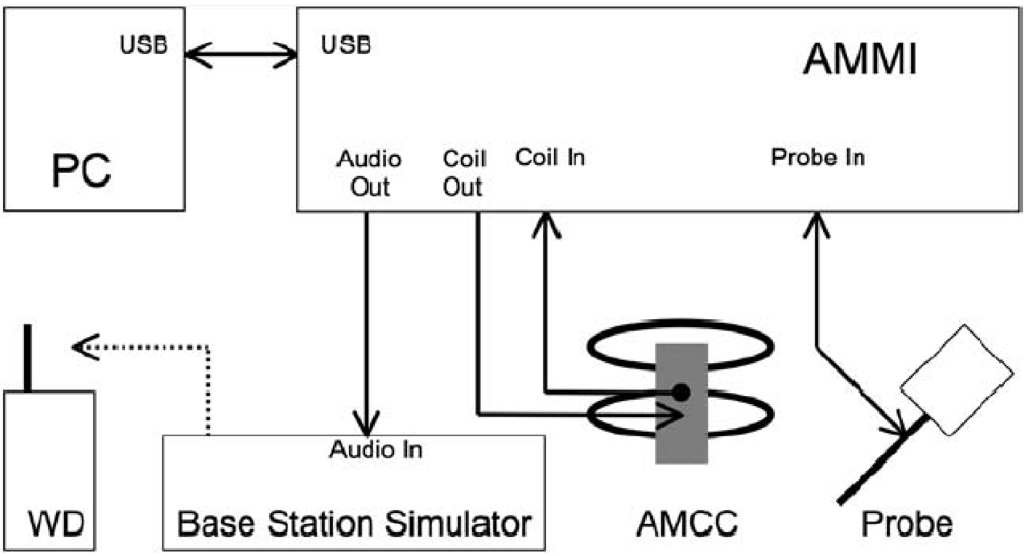


Figure 2 T-Coil Test Measurement Set-up

5.2.2 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 <-100 dB, fully RF shielded)
sensitivity	<-50 dB A/m @ 1 kHz
pre-amplifier	40 dB, symmetric
dimensions	tip diameter / length: 6 / 290 mm, sensor according to ANSI-C63.19

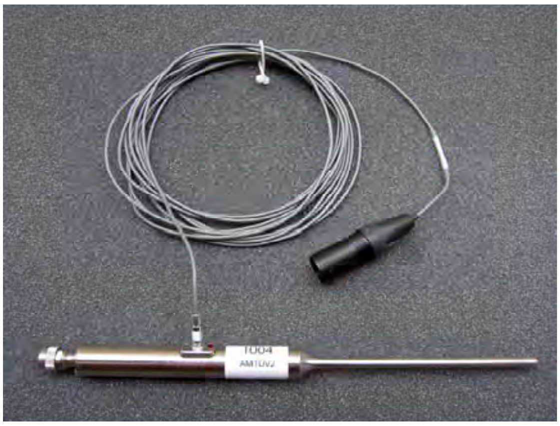


Figure 3 AM1D Probe

5.2.3 Audio Magnetic Measurement Instrument (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.

Figure 4 AMMI front panel

Port description:

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

Figure 5 AMMI rear side

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

5.2.4 Helmholtz Calibration Coil (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 50Ohm, and a shunt resistor of 10Ohm permits monitoring the current with a scale of 1:10

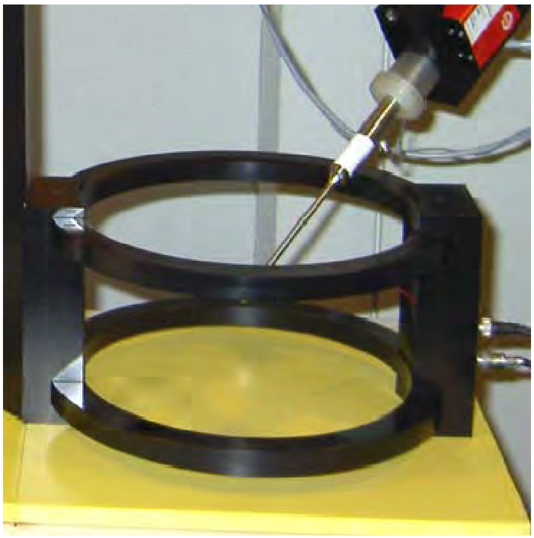


Figure 6 AMCC

Port description:

Signal	Connector	Resistance
Coil In	BNC	Typically 50Ohm
Coil Monitor	BNO	10Ohm±1% (100mV corresponding to 1 A/m)

Specification:

Dimensions	370 x 370 x 196 mm, according to ANSI-C63.19

5.2.5 Test Arch Phantom & Phone Positioner

The Test Arch phantom should be positioned horizontally on a stable surface. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. It 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).
The Device reference point is set for the EUT at 6.3 mm, the Grid reference point is on the upper surface at the origin of the coordinates, and the “user point \Height Check 0.5 mm” is 0.5mm above the center, allowing verication of the gap of 0.5mm while the probe is positioned there.

The Phone Positioner supports accurate and reliable positioning of any phone with effect on near field <±0.5 dB.

Figure 7 T-coil Phantom & Device Holder

5.3 T-Coil measurement points and reference plane

The following figure illustrates the standard probe orientations. Position 1 is the perpendicular orientation of the probe coil; orientation 2 is the transverse orientation. The space between the measurement positions is not fixed. It is recommended that a scan of the WD be performed for each probe coil orientation and that the maximum level recorded be used as the reading for that orientation of the probe coil.

1) The reference plane is 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.

2) The measurement plane is parallel to, and 10 mm in front of, the reference plane.

3) The reference axis is normal to the reference plane and passes through the center of the receiver speaker section (or the center of the hole array); or may be centered on a secondary inductive source. The actual location of the measurement point shall be noted in the test report as the measurement reference point.

4) The measurement points may be located where the axial and radial field intensity measurements are optimum with regard to the requirements. However, the measurement points should be near the acoustic output of the EUT and shall be located in the same half of the phone as the EUT receiver. In a EUT handset with a centered receiver and a circularly symmetrical magnetic field, the measurement axis and the reference axis would coincide.

5) The relative spacing of each measurement orientation is not fixed. The axial and two radial orientations should be chosen to select the optimal position.

6) The measurement point for the axial position is located 10 mm from the reference plane on the measurement axis.

7) The actual location of the measurement point shall be noted in test reports and designated as the measurement reference point.

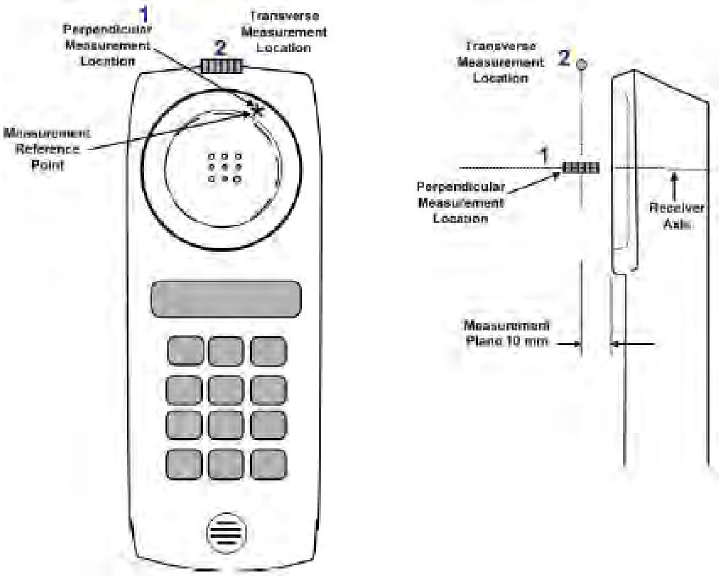


Figure 8 Axis and planes for EUT audio frequency magnetic field measurements

5.4 T-Coil Test Procedueres

The following illustrate a typical test scan over a 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 7.4.2.1.

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 8.3.2.

4) The EUT was positioned in its intended test position, acoustic output point of the device perpendicular to the field probe.

5) The EUT 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 EUT audio output was positioned tangent (as physically possible) to the measurement plane.

6) The EUT'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 EUT by following the three steps, coarse

resolution scan, fine resolution scans, and point measurement, as described in C63.19 per 7.4.4.2. 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.

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 there 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 EUT measurement since the DASY5 system had known the spectrum of the input signal by using a reference job.

11) In SEMCAD postprocessing, 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.

6 T-Coil Performance Requirements

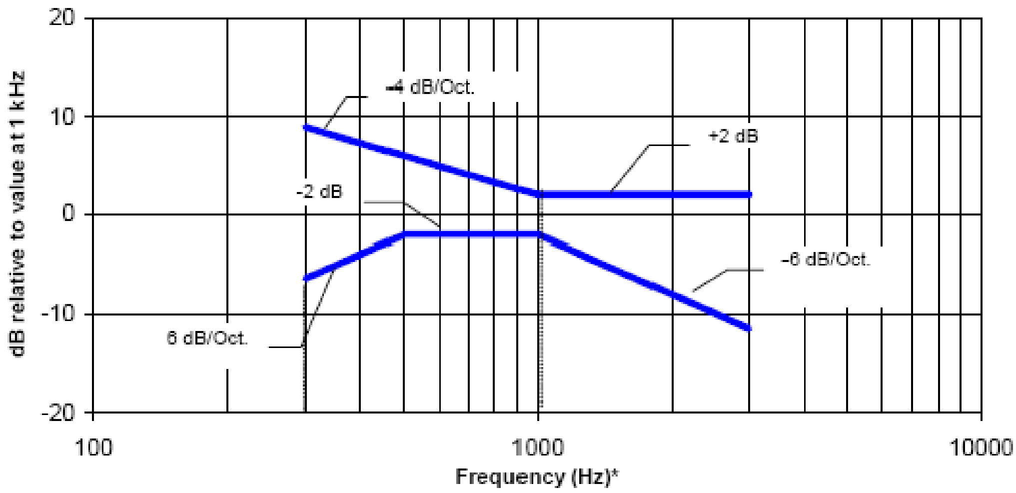
In order to be rated for T-Coil use, a EUT shall meet the requirements for signal level and signal quality contained in this part.

6.1 T-Coil coupling field intensity

When measured as specified in ANSI C63.19, the T-Coil signal shall be ≥ –18 dB (A/m) at 1 kHz, in a 1/3 octave band filter for all orientations.

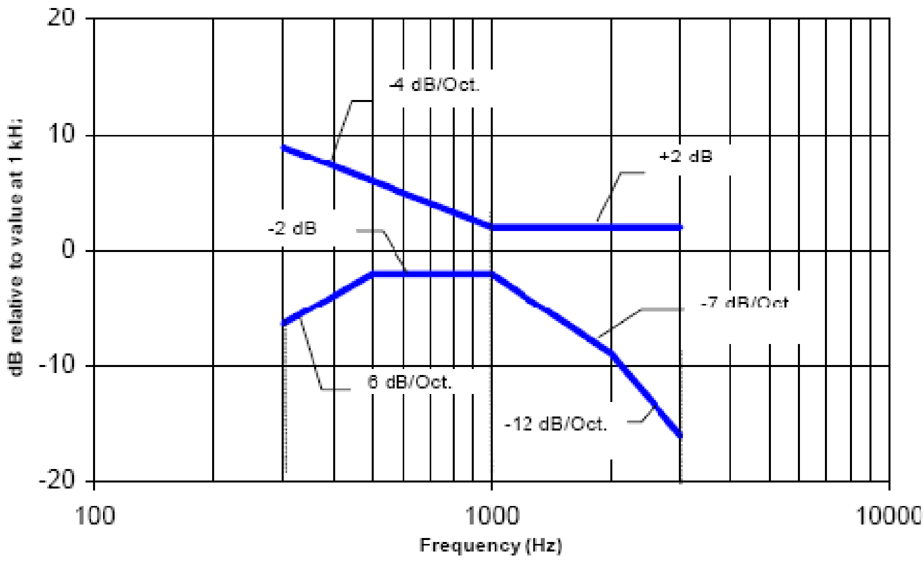
6.2 Frequency response

The frequency response of the axial 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. The following figures provide the boundaries for the specified 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—Frequency response is between 300 Hz and 3000 Hz.

Figure 9 Magnetic field frequency response for EUTs with a field ≤ –15 dB (A/m) at 1 kHz



NOTE—Frequency response is between 300 Hz and 3000 Hz.

Figure 10 Magnetic field frequency response for EUTs with a field that exceeds –15 dB(A/m) at 1 kHz

6.3 Signal quality

This part provides the signal quality requirement for the intended T-Coil signal from a EUT. 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. So, the only criteria that can be measured is the RF immunity in T-Coil mode. This is measured using the same procedure as for the audio coupling mode and at the same levels.

The worst signal quality of the twoT-Coil signal measurements shall be used to determine the T-Coil mode category per Table 1

Table 1: T-Coil signal quality categories

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

6.4 Establish Reference Levelfor GSM / UMTS / CDMA

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), to -18 dBm0 for CDMA and to -16 dBm0 for LTE. 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.
GSM or WCDMA 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. CDMA2000 Determine the 1 kHz input level to generate the desired signal level of -18 dBm0. Select CMU200 Network Bitstream “Codec Cal” to loop the input via the codec to the output. Run the measurement job (AMMI 1 kHz signal with gain 10 inserted) and read the voltage level at the multimeter display “Coil signal”. With Gain 10 setting, the measurement signal difference to the desired signal level of -18 dBm0.
GSM/UMTS Calculations: *3.14 dBm0 = -2.39 dBV -16 dBm0 = -21.53 dBV* *Gain 10 = -19.93 dBV* *-21.53 - (-19.93) = -1.6 dB* *10* [10 ^ ((-1.6) / 20)] = 10 x 0.832 = 8.32* *Required Gain Factor = 10^(-RMS(dB)/20)* *Gain Setting = Required Gain Factor * 8.32* Note: Calculated Gain Setting = Resulting Gain * Required Gain Factor
CDMA Calculations: *3.14 dBm0 = -2.4 dBV -18 dBm0 = -23.54 dBV* *Gain 10 = -19.74 dBV* *-23.54 - (-19.74) = -3.8 dB* *10* [10 ^ ((-3.8) / 20)] = 10 x 0.646 = 6.46* *Required Gain Factor = 10^(-RMS(dB)/20)* *Gain Setting = Required Gain Factor * 6.46* 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]
GSM/UMTS	48k_voice_1kHz	1	16.2	-12.7	4.33	36.02	36.02
	48k_voice_300Hz ~ 3kHz	2	21.6	-18.6	8.48	70.53	70.53
CDMA	48k_voice_1kHz	1	16.2	-12.7	4.33	27.96	27.96
	48k_voice_300Hz ~ 3kHz	2	21.6	-18.6	8.48	54.75	54.75

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.

6.5 Establish Reference Level for VoLTE

The normal speech input level -16dBm0 is used for VoLTE T-coil performance evaluation. The CMW500 base station simulator was manually configured to ensure that the settings for speech input full scale levels resulted in the -16dBm0 speech input level to the DUT for the VoLTE connection.

LTE Calculations:

3.14 dBm0 = -3.01 dBV   -16 dBm0 = -25.07dBV

Gain 10 = -20.02dBV

-25.07 - (-20.02) = -5.05dB

10 [10 ^ ((-5.05) / 20)] = 10 x 0.559= 5.59*

Required Gain Factor = 10^(-RMS(dB)/20)

*Gain Setting = Required Gain Factor * 5.59*

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

According to the gain setting for 1kHz sine wave, determine the gain setting for signals below

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

Signal [file name]	Duration [s]	Peak-to-RMS [dB]	RMS [dB]	Required gain factor *)	Gain setting
1kHz sine	---	3.0	0.0	1.00	
48k_1.025kHz_10s.wav	10	3.0	0.0	1.00	
48k_1kHz_3.15kHz_10s.wav	10	6.0	-3.0	1.42	
48k_315Hz_1kHz_10s.wav	10	6.0	-2.9	1.40	
48k_csek_8k_441_white_10s.wav	10	13.8	-10.5	3.34	
48k_multisine_50-5000_10s.wav	10	11.1	-7.9	2.49	
48k_voice_1kHz_1s.wav	1	16.2	-12.7	4.33	
48k_voice_300-3000_2s.wav	2	21.6	-18.6	8.48	

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

Insert the gain applicable for your setup in the last column of the table.

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	24.21	24.21
48k_voice_300Hz ~ 3kHz	2	21.6	-18.6	8.48	47.41	47.41

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.

7 Summary Test Results

Band	Channel	Probe Orientation	Measurement Position (x,y) [mm]	ABM1≥ -18 dB(A/m) (Signal)	SNR (ABM1/ABM2) (dB)	Frequency Response	T-Rating
CDMA BC0	384	y (Radial):	(-4.2, 16.7, 3.7)	-14.54	34.19	/	T4
		z (Axial):	(0, 4.2, 3.7)	-1.88	43.75	Pass	T4
CDMA BC1	600	y (Radial):	(-4.2, 16.7, 3.7)	-14.56	34.28	/	T4
		z (Axial):	(0, 4.2, 3.7)	-1.94	43.50	Pass	T4
CDMA BC10	580	y (Radial):	(-4.2, 16.7, 3.7)	-14.55	34.13	/	T4
		z (Axial):	(0, 4.2, 3.7)	-1.93	44.37	Pass	T4
LTE Band 2	18900	y (Radial):	(-4.2,4.2,3.7)	-12.22	25.68	/	T3
		z (Axial):	(-8.3,-4.2,3.7)	-8.82	30.80	PASS	T4
LTE Band 4	20175	y (Radial):	(-4.2,4.2,3.7)	-11.67	24.96	/	T3
		z (Axial):	(-8.3,-8.3,3.7)	-12.14	30.54	PASS	T4
LTE Band 5	20525	y (Radial):	(-8.3,4.2,3.7)	-16.85	27.27	/	T3
		z (Axial):	(-8.3,-4.2,3.7)	-9.06	31.64	PASS	T4
LTE Band 12	23095	y (Radial):	(-4.2,4.2,3.7)	-12.04	25.95	/	T3
		z (Axial):	(-8.3,-4.2,3.7)	-8.09	32.46	PASS	T4
LTE Band 13	23230	y (Radial):	(-4.2,4.2,3.7)	-11.44	26.45	/	T3
		z (Axial):	(-8.3,-4.2,3.7)	-8.50	32.07	PASS	T4
LTE Band 25	26365	y (Radial):	(-4.2, 4.2, 3.7)	-11.72	27.99	/	T3
		z (Axial):	(-8.3, -4.2, 3.7)	-9.32	34.50	PASS	T4
LTE Band 26	26865	y (Radial):	(-4.2,4.2,3.7)	-10.63	25.59	/	T3
		z (Axial):	(-8.3,-4.2,3.7)	-8.19	31.60	PASS	T4
LTE Band 41	40620	y (Radial):	(-8.3,-4.2,3.7)	-14.62	20.08	/	T3
		z (Axial):	(-8.3,0,3.7)	-6.94	27.68	PASS	T3

Note:
1. The LCD backlight is turn off and volume is adjusted to maximum level during T-Coil testing.
2. Signal strength measurement scan plots are presented in Annex B.

8 Measurement Uncertainty

Measurement uncertainty evaluation template for DUT HAC T-Coil test (ANSI C63.19-2011)

Error source	Type	Uncertainty Value ai (%)	Prob. Dist.	k	ABM1c_i	ABM2c_i	Std. Unc. ABM1 (± %)	Std. Unc. ABM2 (± %)	Degree of freedom V_{eff} or v_i
Probe Sensitivity									
Reference Level	B	3.0	N	1	1	1	3.0	3.0	∞
AMCC Geometry	B	0.4	R	1.732	1	1	0.2	0.2	∞
AMCC Current	B	0.6	R	1.732	1	1	0.3	0.3	∞
Probe Positioning during Calibration	B	0.1	R	1.732	1	1	0.1	0.1	∞
Noise Contribution	B	0.7	R	1.732	0.0143	1	0.0	0.4	∞
Frequency Slope	B	5.9	R	1.732	0.1	1	0.3	3.4	∞
Probe System									
Repeatability / Drift	B	1.0	R	1.732	1	1	0.6	0.6	∞
Linearity / Dynamic Range	B	0.6	R	1.732	1	1	0.3	0.3	∞
Acoustic Noise	B	1.0	R	1.732	0.1	1	0.1	0.6	∞
Probe Angle	B	2.3	R	1.732	1	1	1.3	1.3	∞
Spectral Processing	B	0.9	R	1.732	1	1	0.5	0.5	∞
Integration Time	B	0.6	N	1	1	5	0.6	3.0	∞
Field Distribution	B	0.2	R	1.732	1	1	0.1	0.1	∞
Test Signal									
Ref.Signal Spectral Response	B	0.6	R	1.732	0	1	0.0	0.3	∞
Positioning									
Probe Positioning	B	1.9	R	1.732	1	1	1.1	1.1	∞
Phantom Thickness	B	0.9	R	1.732	1	1	0.5	0.5	∞
EUT Positioning	B	1.9	R	1.732	1	1	1.1	1.1	∞
External Contributions									
RF Interference	B	0.0	R	1.732	1	0.3	0.0	0.0	∞
Test Signal Variation	B	2.0	R	1.732	1	1	1.2	1.2	∞
Combined Std. Uncertainty (ABM Field)							4.0	6.1	
Expanded Std. Uncertainty							8.0	12.2	

9 Main Test Instruments

Name	Manufacturer	Type	Serial Number	Last Cal.	Cal. Due Date
Audio Magnetic 1D Field Probe	SPEAG	AM1DV3	3082	2017-11-21	2020-11-20
DAE	SPEAG	DAE4	1291	2017-10-31	2018-10-30
Universal Radio Communication Tester	R&S	CMU 200	118133	2018-05-20	2019-05-19
Universal Radio Communication Tester	R&S	CMW 500	146734	2018-05-20	2019-05-19
Audio Magnetic Calibration Coil	SPEAG	AMCC	1101	2017-11-22	2020-11-21
Audio Measuring Instrument	SPEAG	AMMI	1112	2017-11-22	2020-11-21
TMFS	SPEAG	SE UMS 021 AA	1018	2017-11-22	2020-11-21
Hygrothermograph	Anymetr	NT-311	20150731	2018-05-17	2019-05-16
HAC Phantom	SPEAG	SD HAC P01 BB	1117	2017-11-22	2020-11-21
Software for Test	Speag	DASY5	52.8.8.1222	/	/
Software for Tissue	Agilent	85070	E06.01.36	/	/

*****END OF REPORT *****

ANNEX A: Test Layout

Picture 1: HAC T-Coil System Layout

ANNEX B: Graph Results

T-Coil CDMA BC0 Y transversal

Date: 5/20/2018
Communication System: UID 0, CDMA 835 (0); Frequency: 836.52 MHz;Duty Cycle: 1:1
Ambient Temperature:22.3 ℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 11/21/2017
Electronics: DAE4 Sn1291; Calibrated: 10/31/2017
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)

Coolpad 3310A CDMA BC0 HAC_TCoil_WD_Emission/General Scans/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 33.76
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.16 dB
Device Reference Point: 0, 0, -6.3 mm

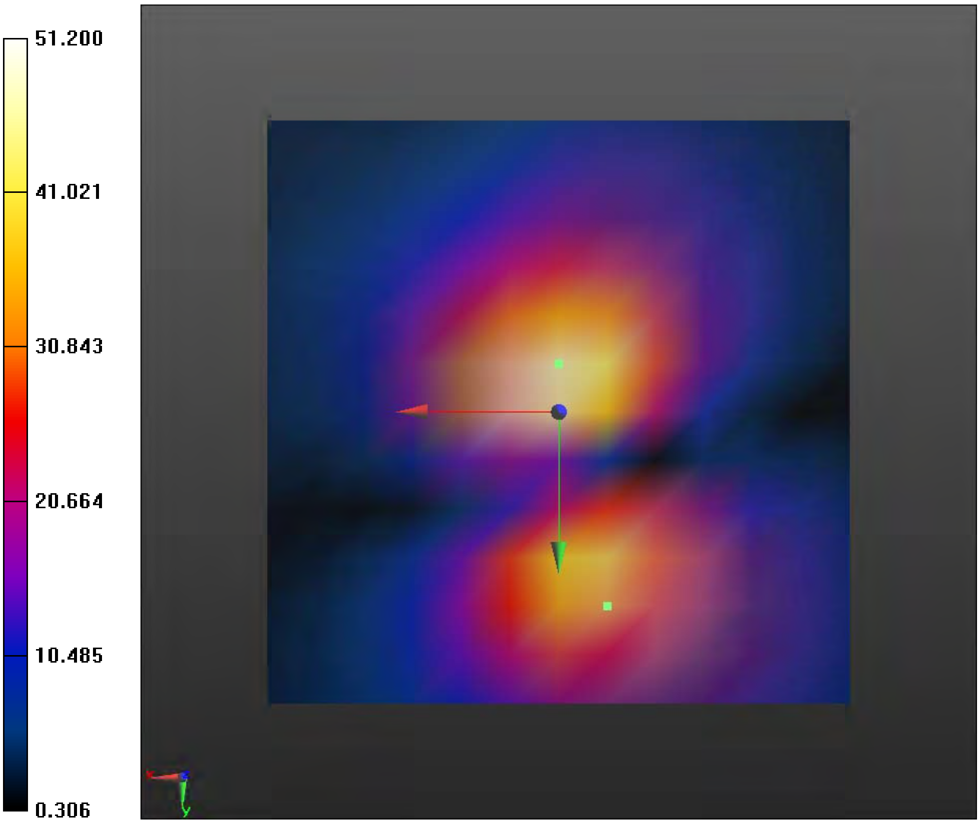
Cursor:

ABM1/ABM2 = 34.19 dB

ABM1 comp = -14.54 dBA/m

BWC Factor = 0.16 dB

Location: -4.2, 16.7, 3.7 mm



T-Coil CDMA BC0 Z Axial

Date: 5/20/2018

Communication System: UID 0, CDMA 835 (0); Frequency: 836.52 MHz;Duty Cycle: 1:1

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

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)

Coolpad 3310A CDMA BC0 HAC_TCoil_WD_Emission/General Scans/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

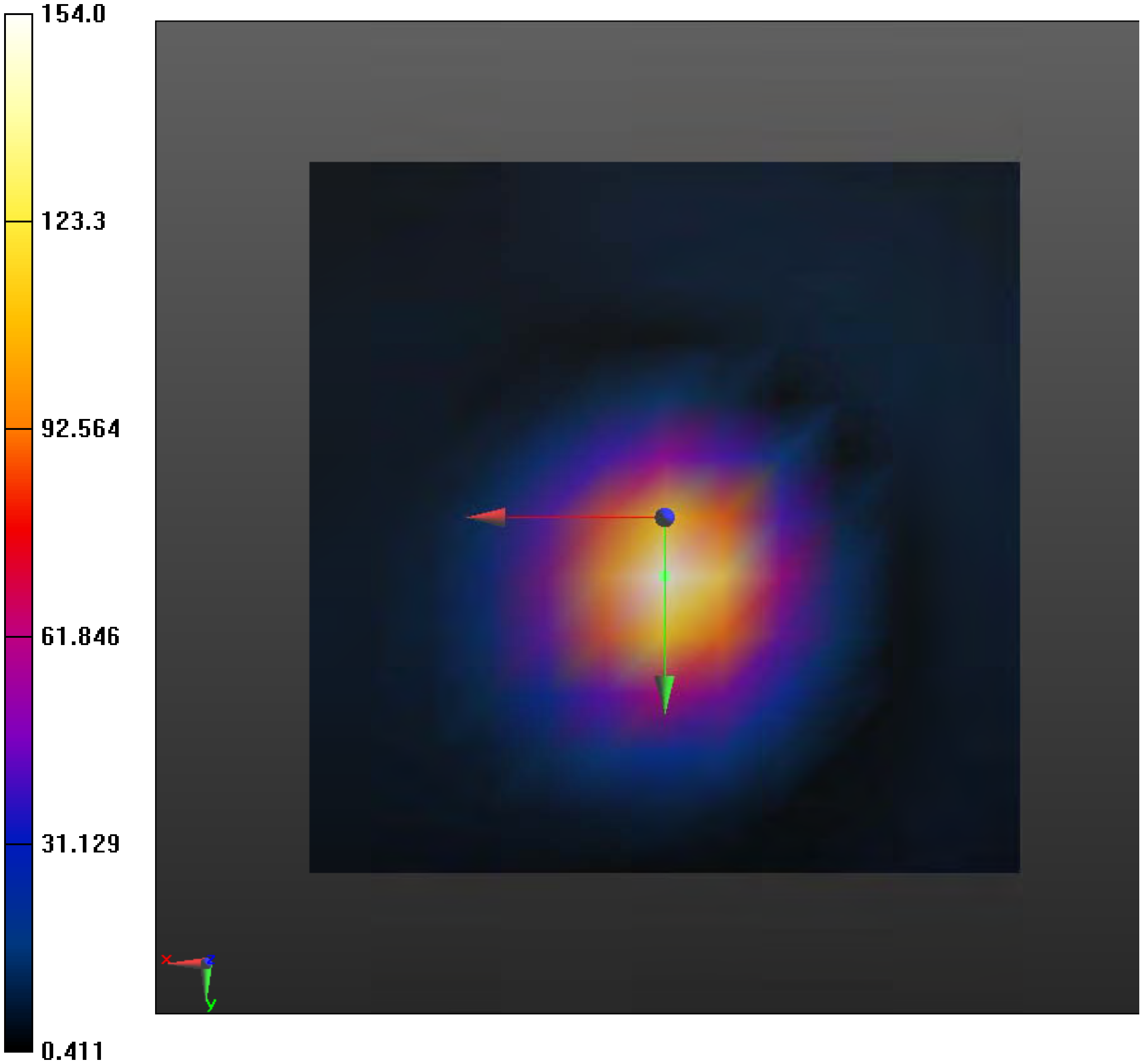
Cursor:

ABM1/ABM2 = 43.75 dB

ABM1 comp = -1.88 dBA/m

BWC Factor = 0.16 dB

Location: 0, 4.2, 3.7 mm



Coolpad 3310A CDMA BC0 HAC_TCoil_WD_Emission/General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav

Output Gain: 66.12

Measure Window Start: 300ms

Measure Window Length: 2000ms

BWC applied: 10.81 dB

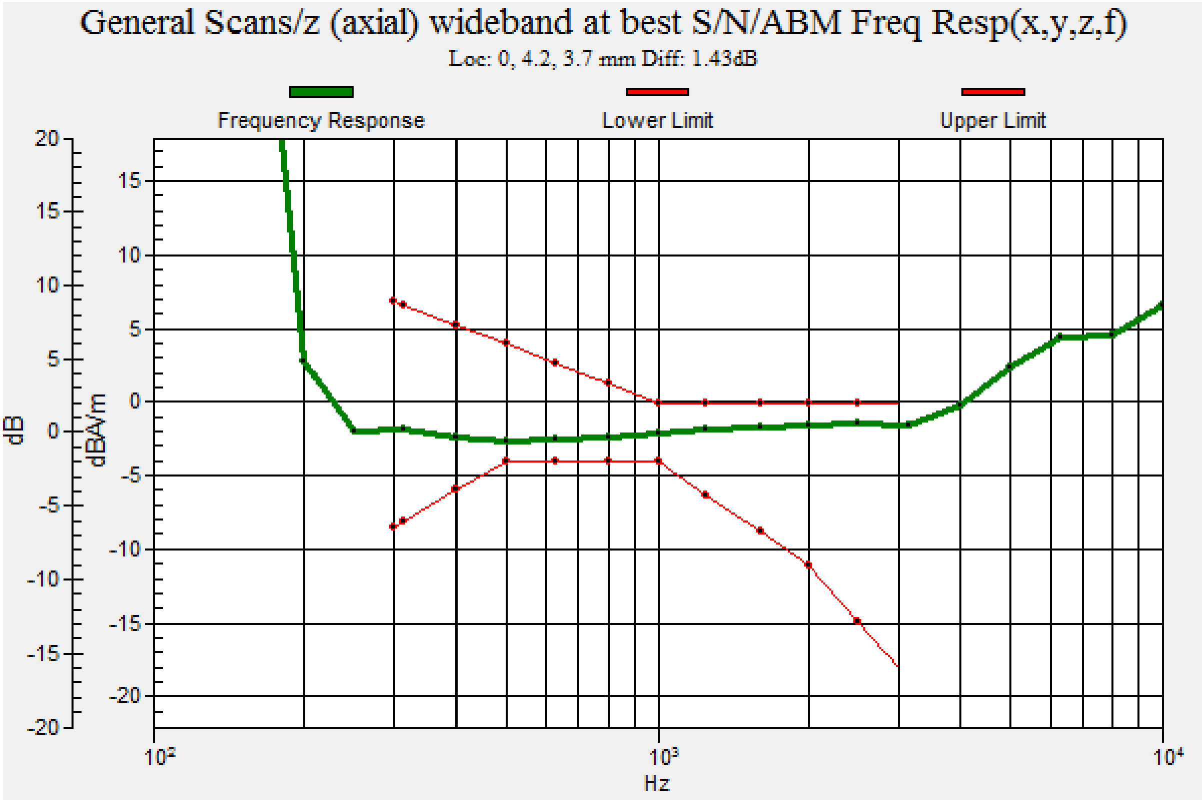
Device Reference Point: 0, 0, -6.3 mm

Cursor:

Diff = 1.43 dB

BWC Factor = 10.81 dB

Location: 0, 4.2, 3.7 mm



T-Coil CDMA BC1 Y transversal

Date: 5/20/2018

Communication System: UID 0, CDMA 1900 (0); Frequency: 1880 MHz;Duty Cycle: 1:1

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

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)

Z6400C WCDMA B4 HAC_TCoil_WD_Emission/General Scans/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

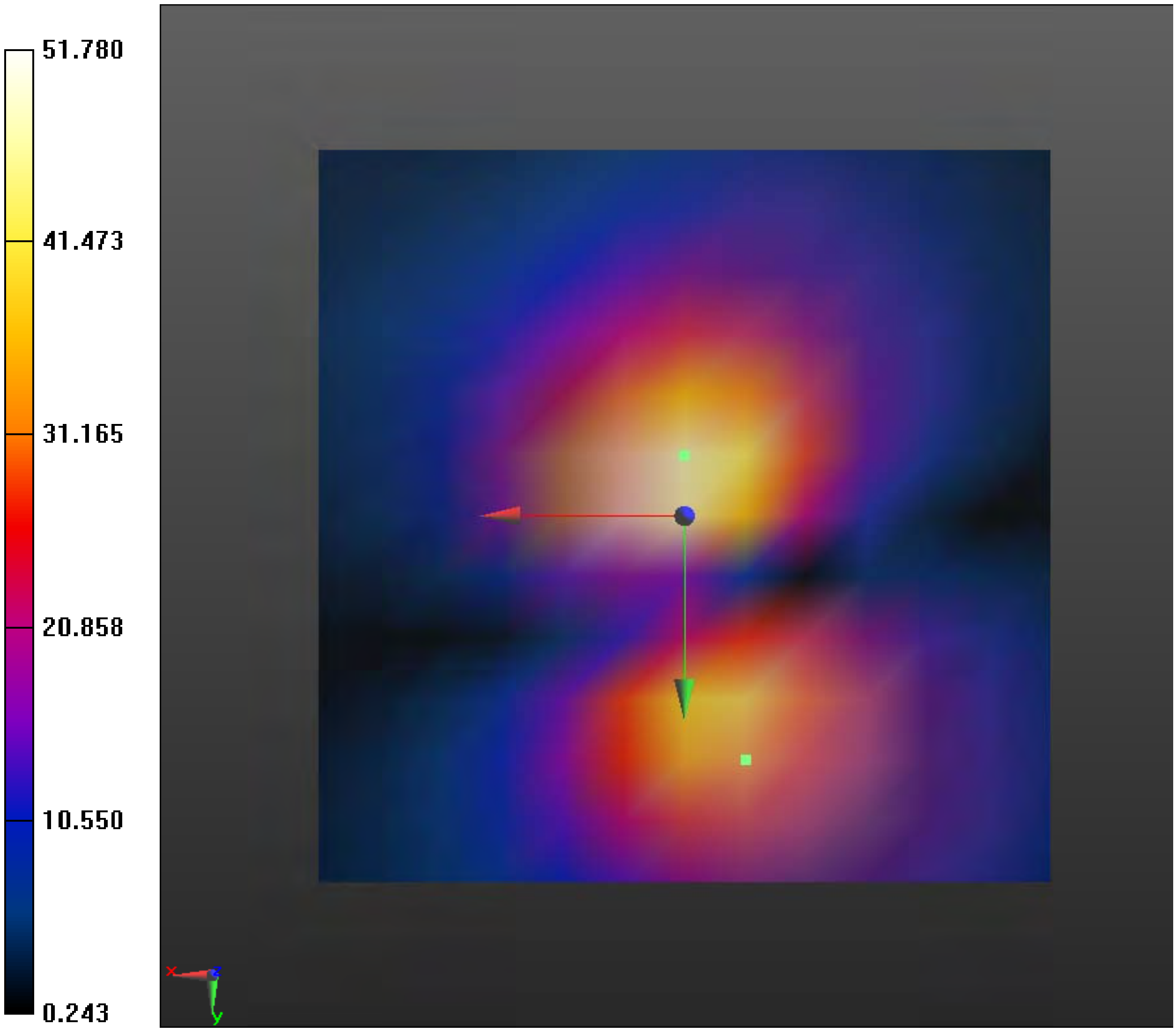
Cursor:

ABM1/ABM2 = 34.28 dB

ABM1 comp = -14.56 dBA/m

BWC Factor = 0.16 dB

Location: -4.2, 16.7, 3.7 mm



T-Coil CDMA BC1 Z Axial

Date: 5/20/2018

Communication System: UID 0, CDMA 1900 (0); Frequency: 1880 MHz;Duty Cycle: 1:1

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

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)

Coolpad 3310A WCDMA B4 HAC_TCoil_WD_Emission/General Scans/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

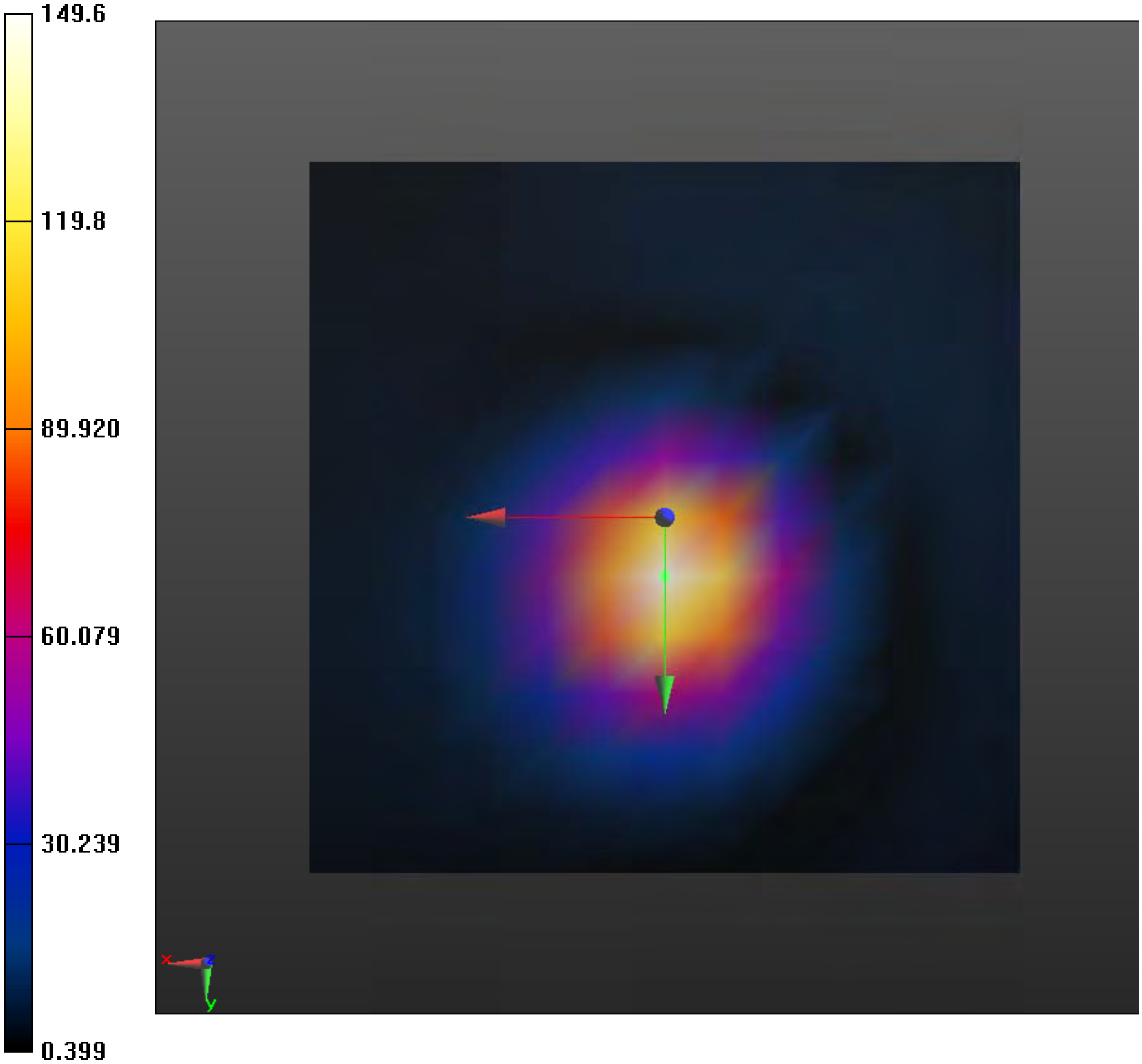
Cursor:

ABM1/ABM2 = 43.50 dB

ABM1 comp = -1.94 dBA/m

BWC Factor = 0.16 dB

Location: 0, 4.2, 3.7 mm



Coolpad 3310A WCDMA B4 HAC_TCoil_WD_Emission/General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav

Output Gain: 66.12

Measure Window Start: 300ms

Measure Window Length: 2000ms

BWC applied: 10.81 dB

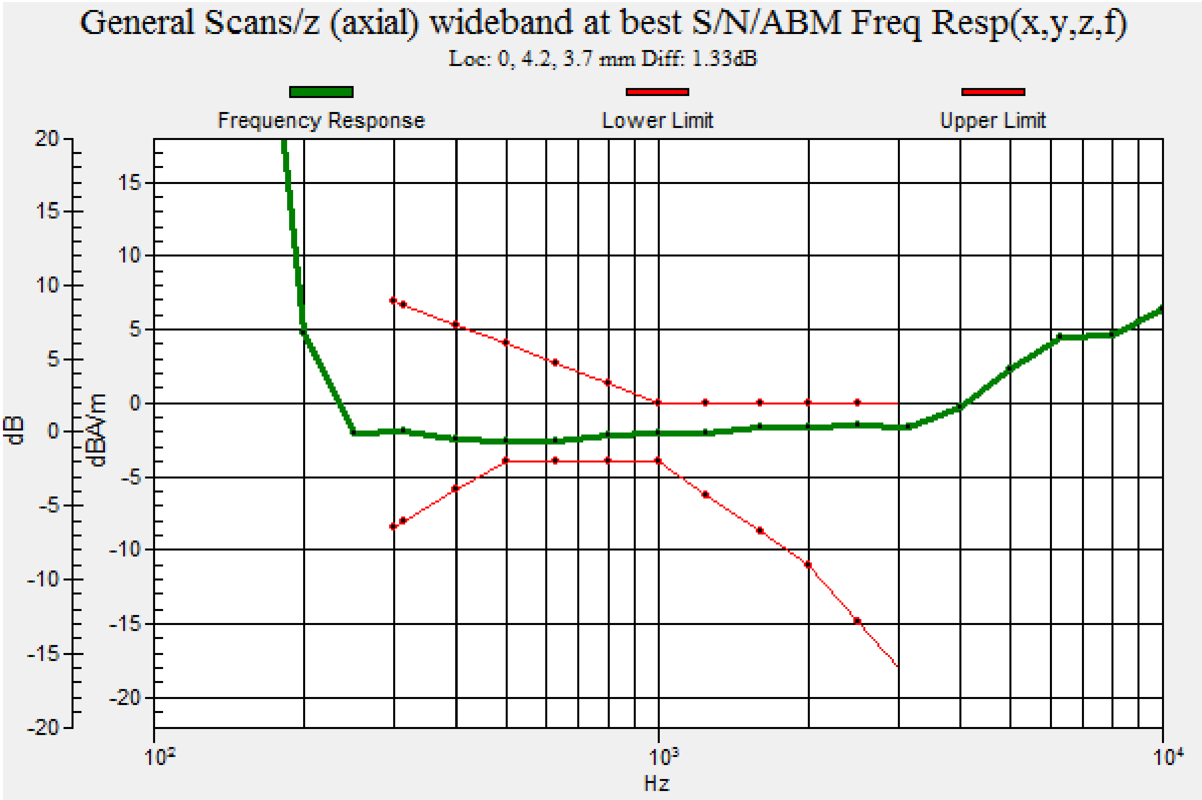
Device Reference Point: 0, 0, -6.3 mm

Cursor:

Diff = 1.33 dB

BWC Factor = 10.81 dB

Location: 0, 4.2, 3.7 mm



T-Coil CDMA BC10 Y transversal

Date: 5/20/2018

Communication System: UID 0, CDMA 835 (0); Frequency: 820.5 MHz;Duty Cycle: 1:1

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

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)

Coolpad 3310A CDMA BC10 HAC_TCoil_WD_Emission/General Scans/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

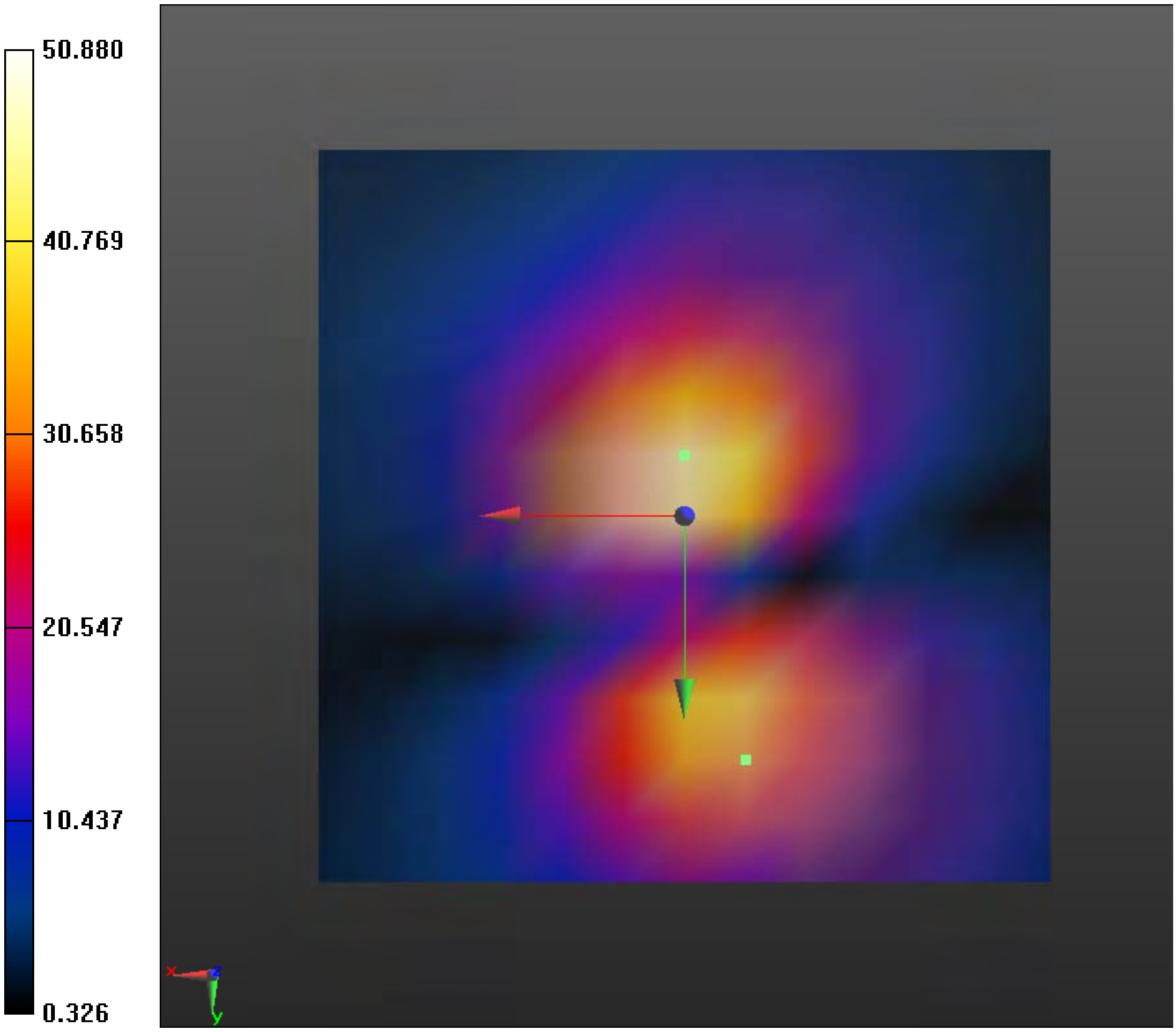
Cursor:

ABM1/ABM2 = 34.13 dB

ABM1 comp = -14.55 dBA/m

BWC Factor = 0.16 dB

Location: -4.2, 16.7, 3.7 mm



T-Coil CDMA BC10 Z Axial

Date: 5/20/2018

Communication System: UID 0, CDMA 835 (0); Frequency: 820.5 MHz;Duty Cycle: 1:1

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

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)

Coolpad 3310A CDMA BC10 HAC_TCoil_WD_Emission/General Scans/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

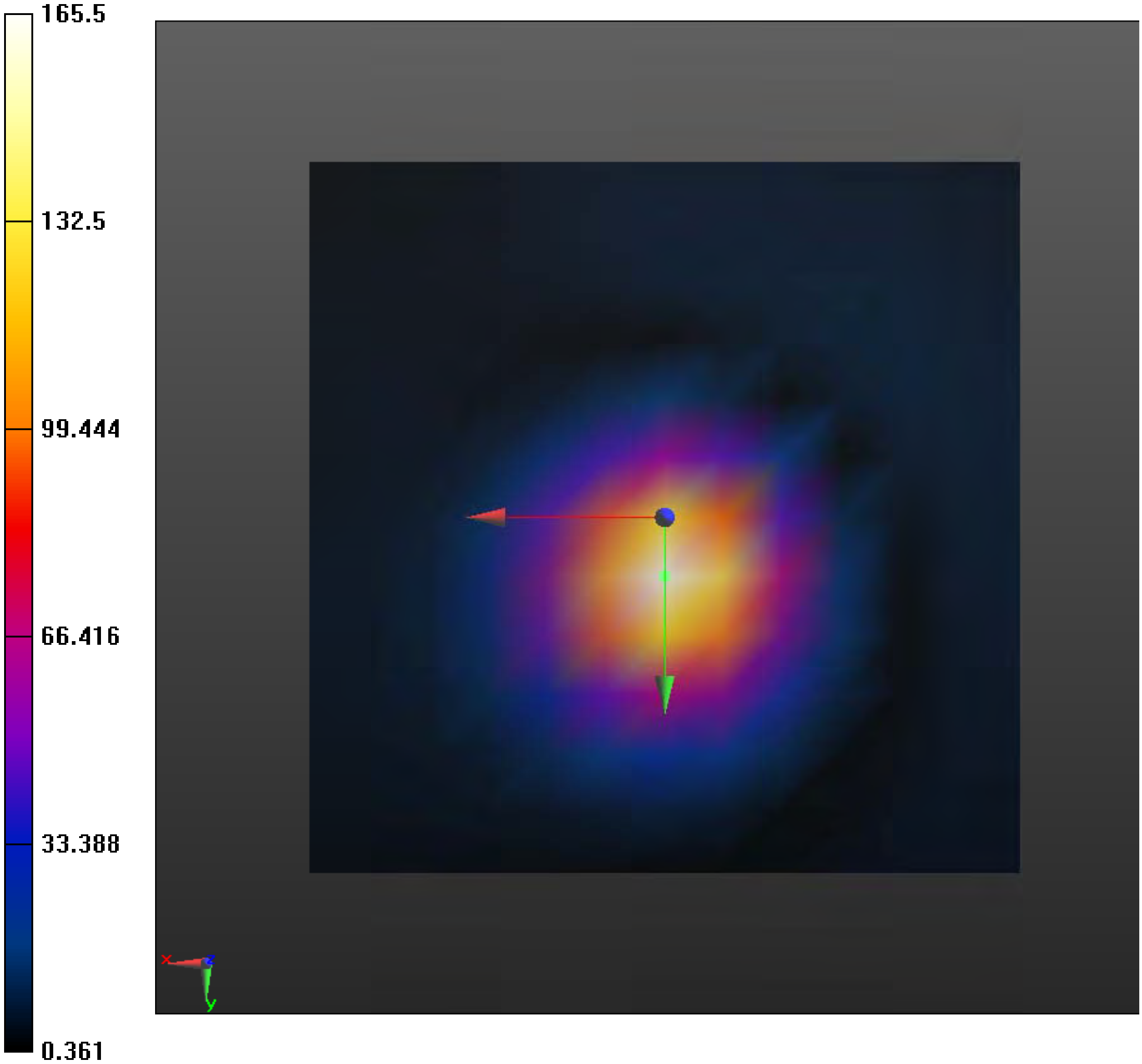
Cursor:

ABM1/ABM2 = 44.37 dB

ABM1 comp = -1.93 dBA/m

BWC Factor = 0.16 dB

Location: 0, 4.2, 3.7 mm



Coolpad 3310A CDMA BC10 HAC_TCoil_WD_Emission/General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav

Output Gain: 66.12

Measure Window Start: 300ms

Measure Window Length: 2000ms

BWC applied: 10.81 dB

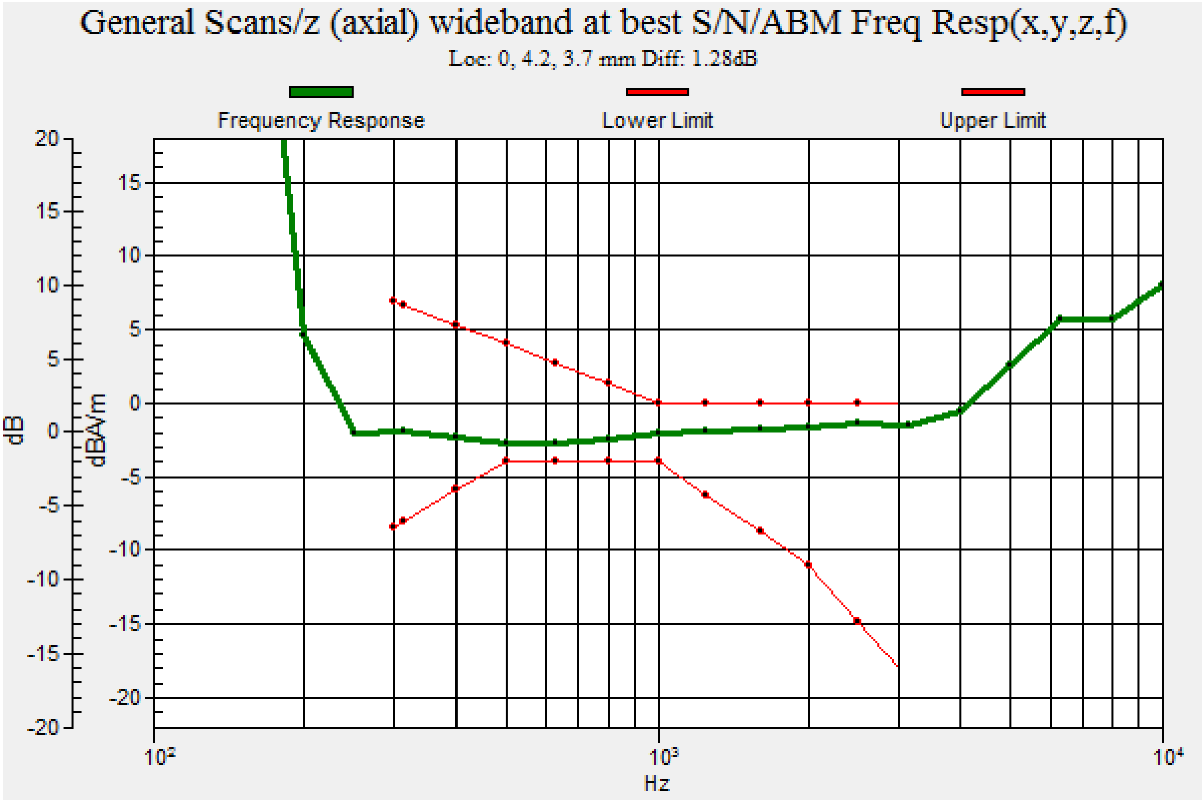
Device Reference Point: 0, 0, -6.3 mm

Cursor:

Diff = 1.28 dB

BWC Factor = 10.81 dB

Location: 0, 4.2, 3.7 mm



T-Coil LTE Band 2 Y transversal

Date: 5/20/2018

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

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B2 HAC_TCoil_WD_Emission/General Scans/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

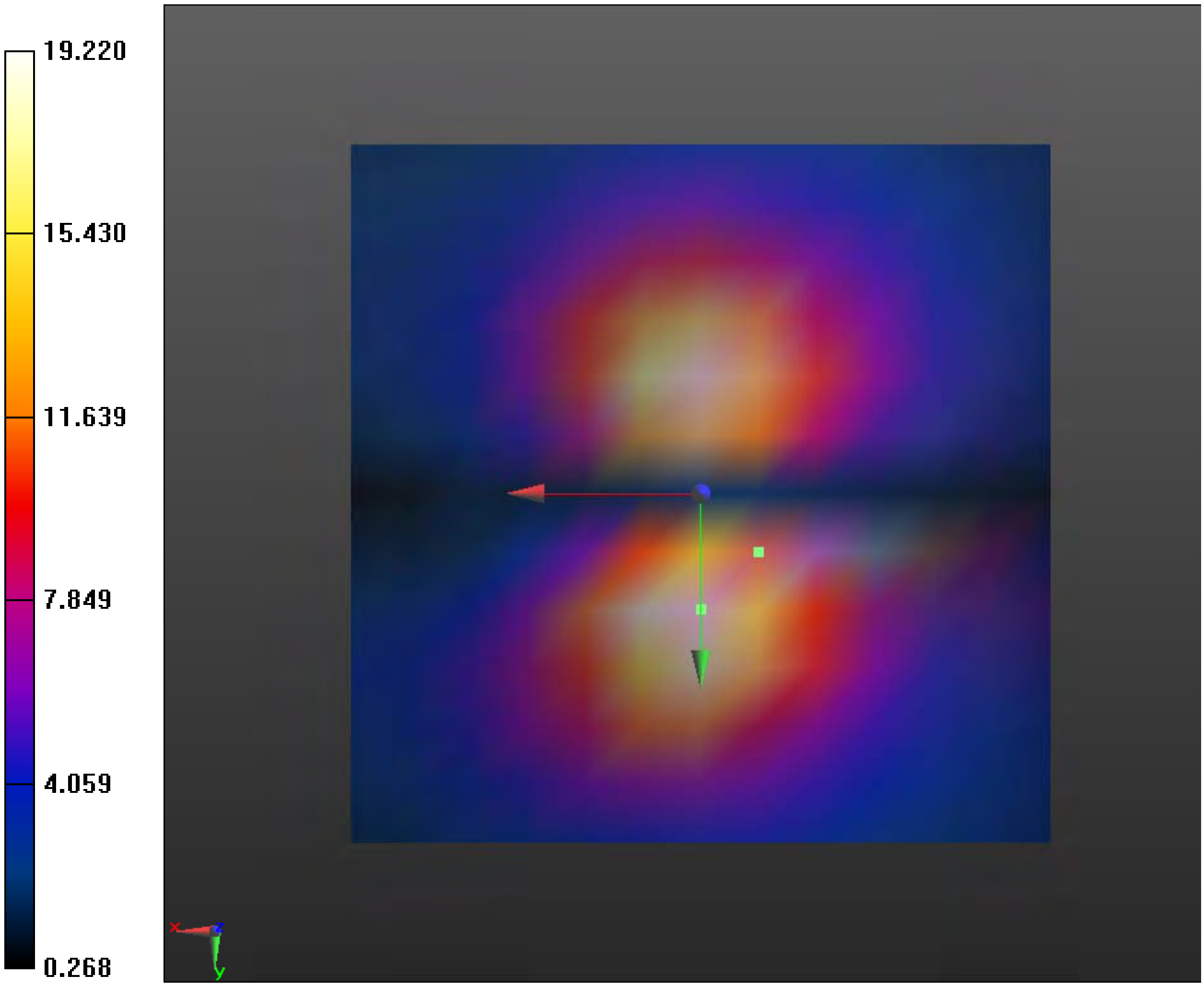
Cursor:

ABM1/ABM2 = 25.68 dB

ABM1 comp = -12.22 dBA/m

BWC Factor = 0.16 dB

Location: -4.2, 4.2, 3.7 mm



T-Coil LTE Band 2 Z Axial

Date: 5/20/2018

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

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B2 HAC_TCoil_WD_Emission/General Scans/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

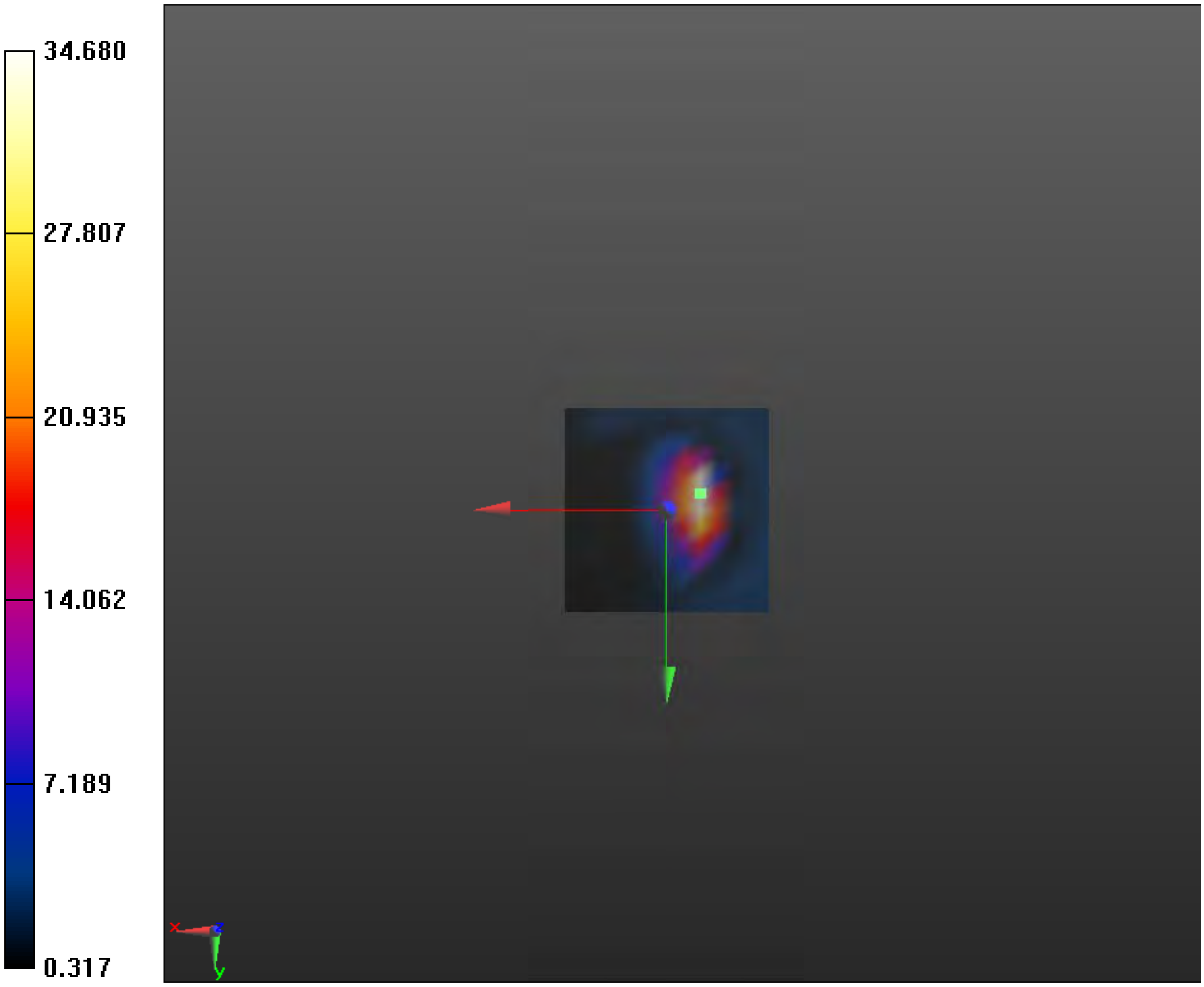
Cursor:

ABM1/ABM2 = 30.80 dB

ABM1 comp = -8.82 dBA/m

BWC Factor = 0.16 dB

Location: -8.3, -4.2, 3.7 mm



Coolpad 3310A LTE B2 HAC_TCoil_WD_Emission/General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav

Output Gain: 66.12

Measure Window Start: 300ms

Measure Window Length: 2000ms

BWC applied: 10.80 dB

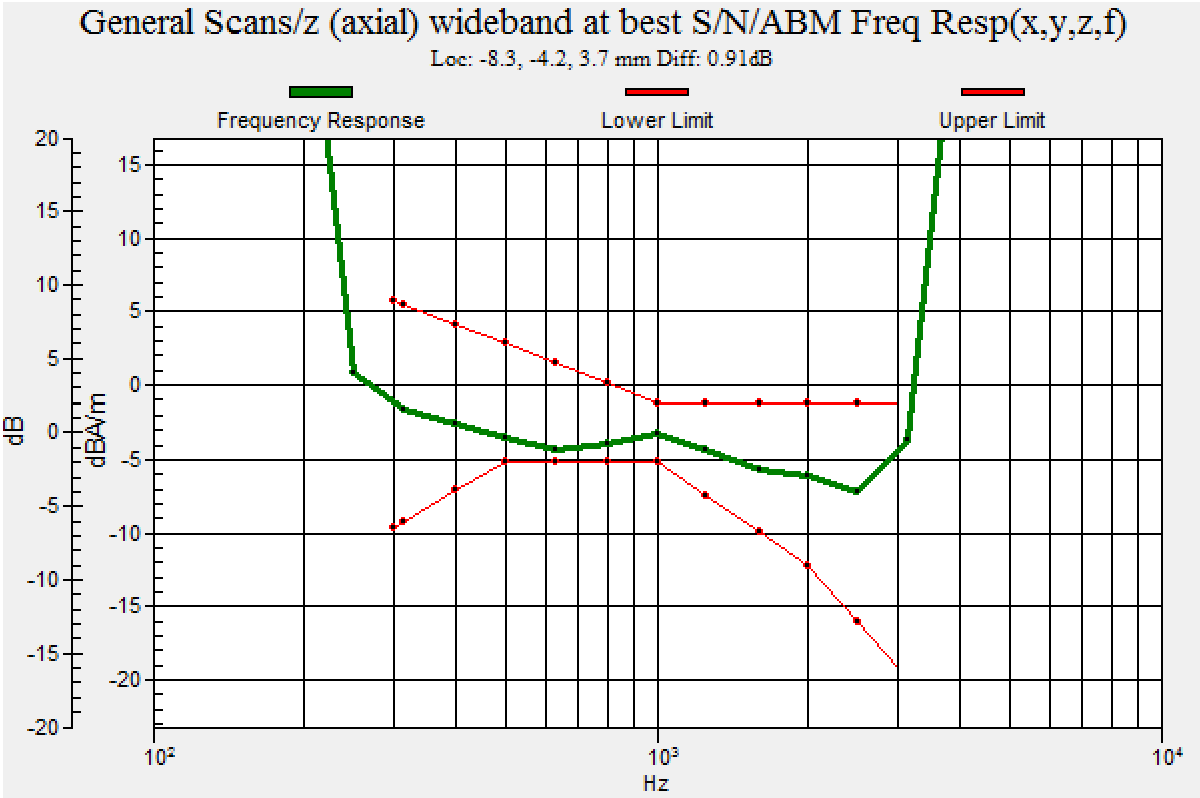
Device Reference Point: 0, 0, -6.3 mm

Cursor:

Diff = 0.91 dB

BWC Factor = 10.80 dB

Location: -8.3, -4.2, 3.7 mm



T-Coil LTE Band 4 Y transversal

Date: 5/20/2018
Communication System: UID 0, LTE (0); Frequency: 1732.5 MHz;Duty Cycle: 1:1
Ambient Temperature:22.3 ℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 11/21/2017
Electronics: DAE4 Sn1291; Calibrated: 10/31/2017
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B4 HAC_TCoil_WD_Emission/General Scans/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 33.76
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.16 dB
Device Reference Point: 0, 0, -6.3 mm

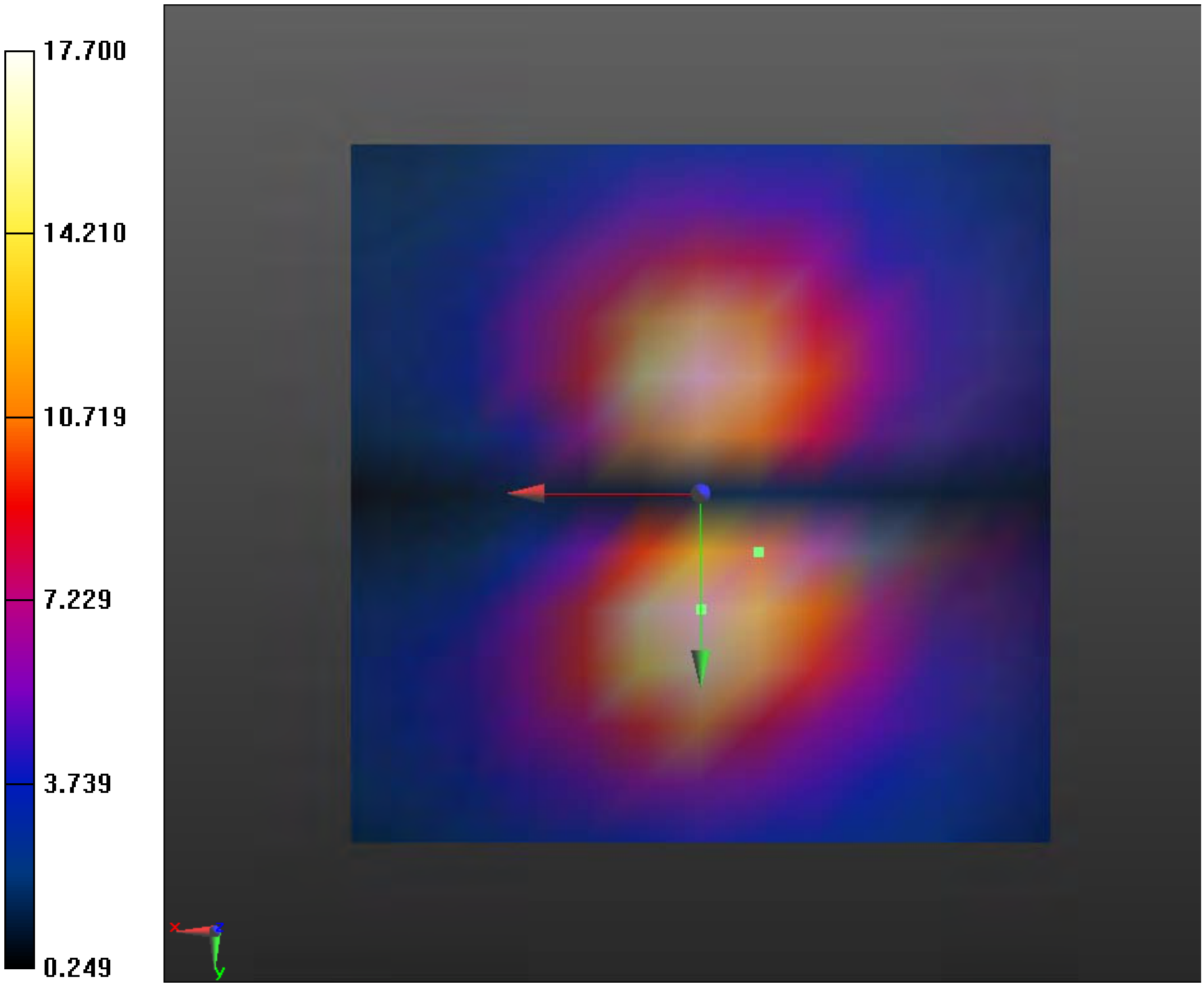
Cursor:

ABM1/ABM2 = 24.96 dB

ABM1 comp = -11.67 dBA/m

BWC Factor = 0.16 dB

Location: -4.2, 4.2, 3.7 mm



T-Coil LTE Band 4 Z Axial

Date: 5/20/2018
Communication System: UID 0, LTE (0); Frequency: 1732.5 MHz;Duty Cycle: 1:1
Ambient Temperature:22.3 ℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 11/21/2017
Electronics: DAE4 Sn1291; Calibrated: 10/31/2017
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B4 HAC_TCoil_WD_Emission/General Scans/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 33.76
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.16 dB
Device Reference Point: 0, 0, -6.3 mm

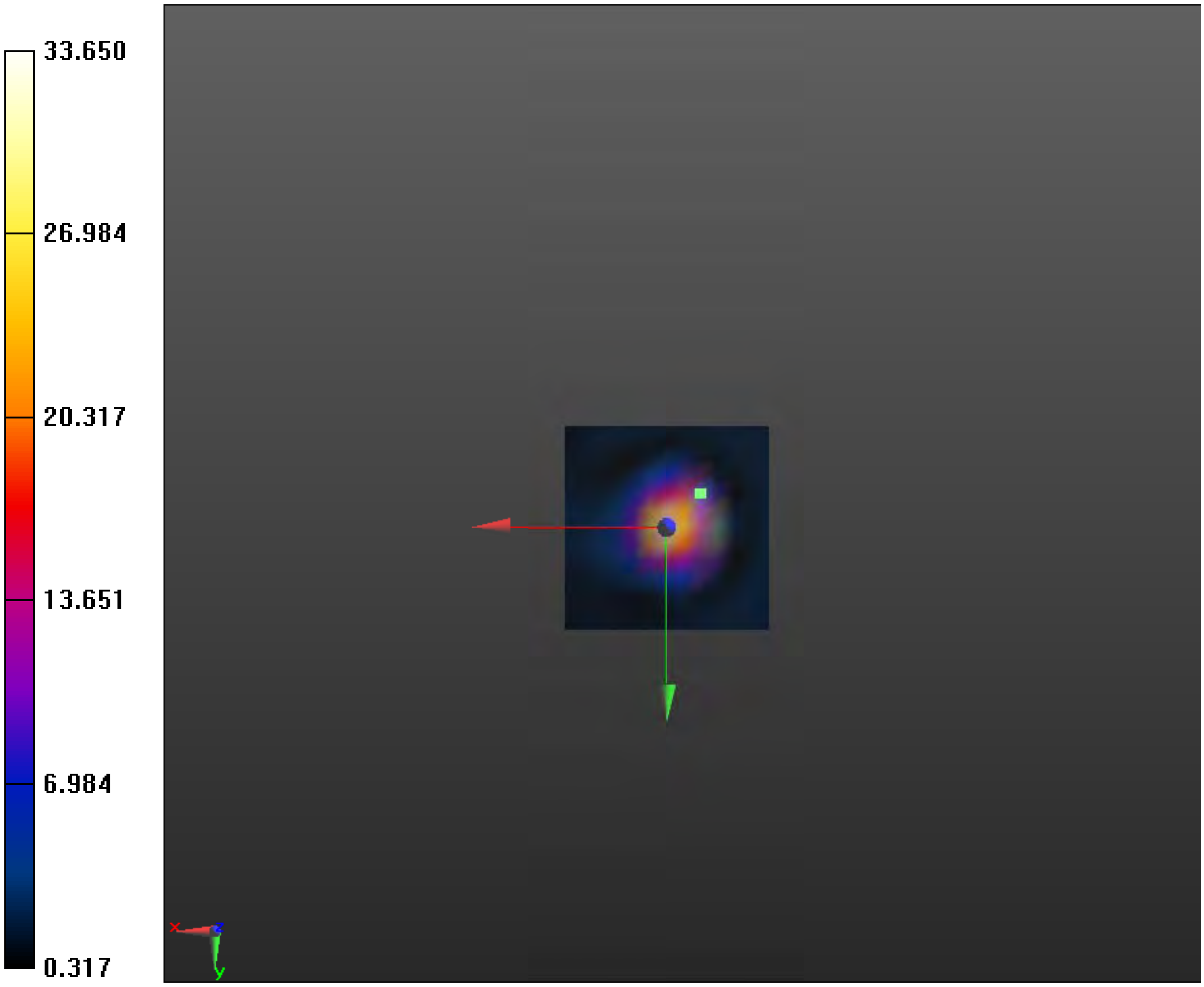
Cursor:

ABM1/ABM2 = 30.54 dB

ABM1 comp = -12.14 dBA/m

BWC Factor = 0.16 dB

Location: -8.3, -8.3, 3.7 mm



Coolpad 3310A LTE B4 HAC_TCoil_WD_Emission/General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav

Output Gain: 66.12

Measure Window Start: 300ms

Measure Window Length: 2000ms

BWC applied: 10.80 dB

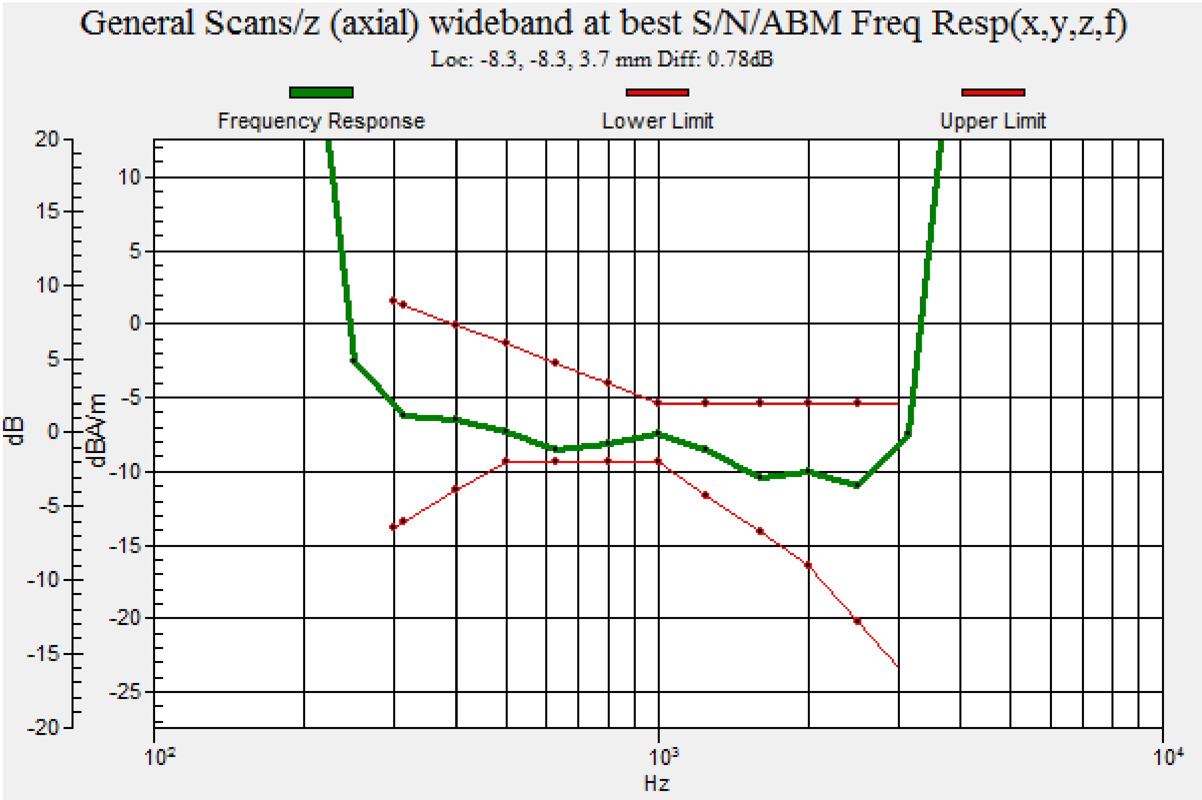
Device Reference Point: 0, 0, -6.3 mm

Cursor:

Diff = 0.78 dB

BWC Factor = 10.80 dB

Location: -8.3, -8.3, 3.7 mm



T-Coil LTE Band 5 Y transversal

Date: 5/20/2018

Communication System: UID 0, LTE (0); Frequency: 836.5 MHz;Duty Cycle: 1:1

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B5 HAC_TCoil_WD_Emission/General Scans/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

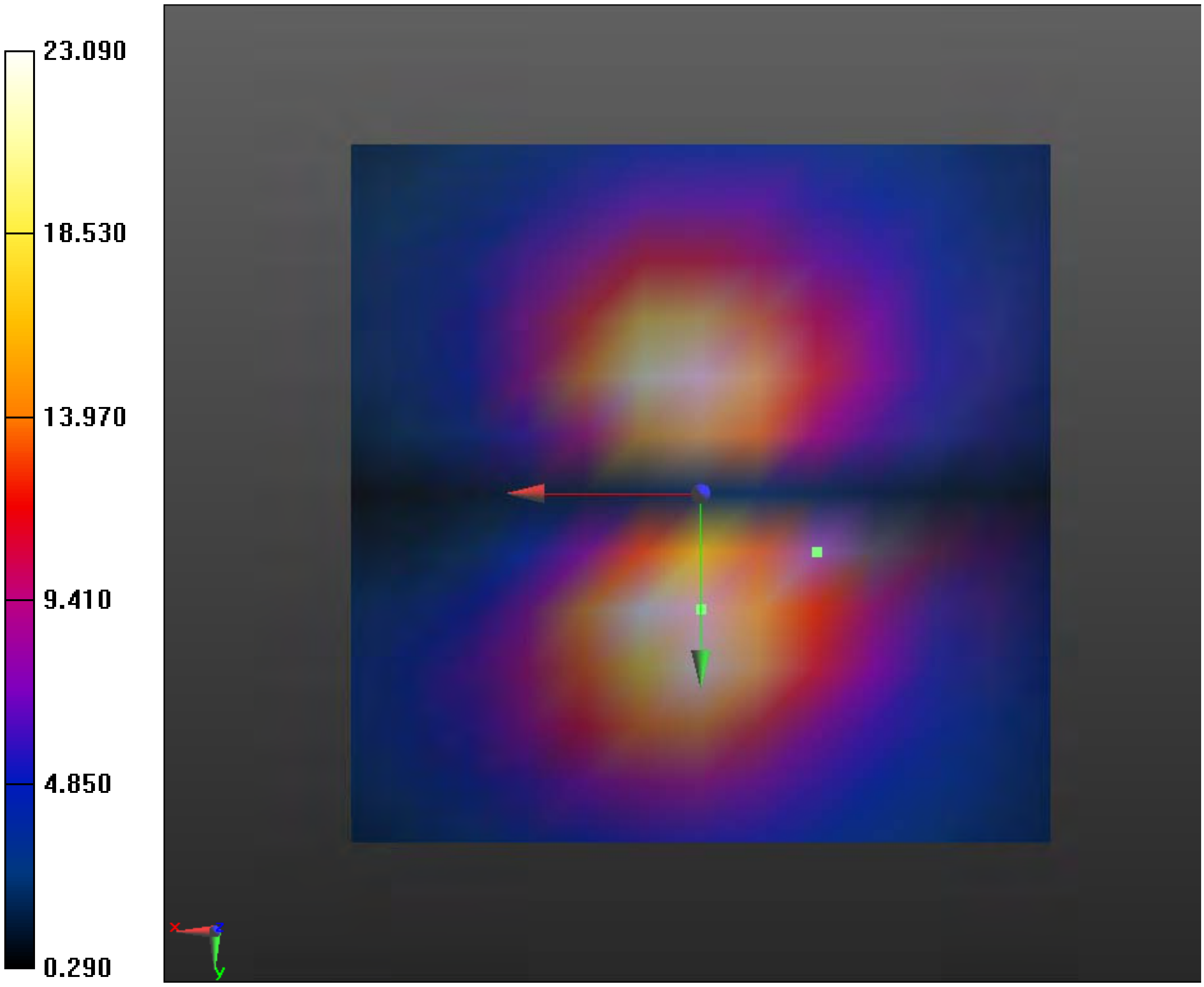
Cursor:

ABM1/ABM2 = 27.27 dB

ABM1 comp = -16.85 dBA/m

BWC Factor = 0.16 dB

Location: -8.3, 4.2, 3.7 mm



T-Coil LTE Band 5 Z Axial

Date: 5/20/2018

Communication System: UID 0, LTE (0); Frequency: 836.5 MHz;Duty Cycle: 1:1

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B5 HAC_TCoil_WD_Emission/General Scans/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

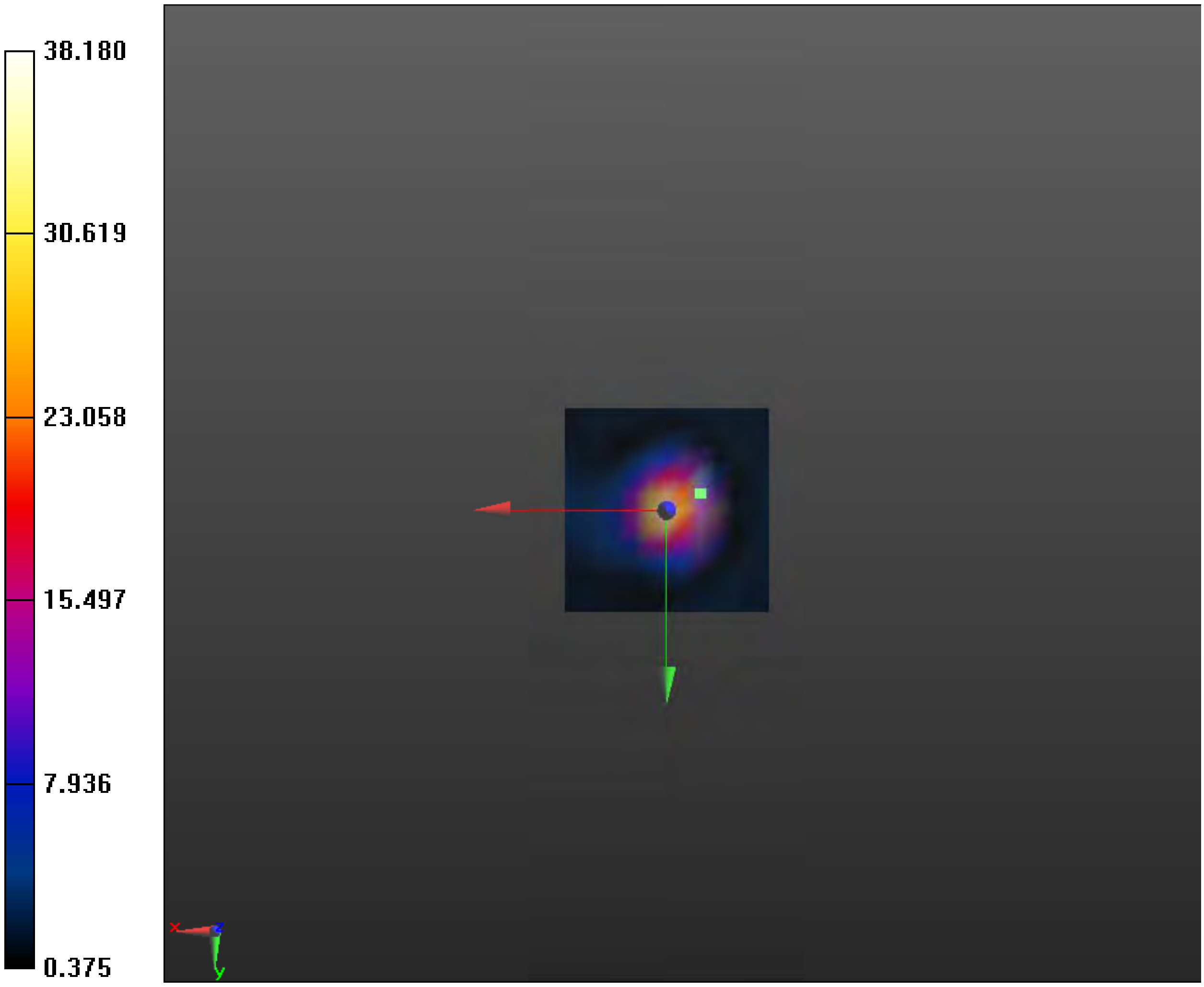
Cursor:

ABM1/ABM2 = 31.64 dB

ABM1 comp = -9.06 dBA/m

BWC Factor = 0.16 dB

Location: -8.3, -4.2, 3.7 mm



Coolpad 3310A LTE B5 HAC_TCoil_WD_Emission/General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav

Output Gain: 66.12

Measure Window Start: 300ms

Measure Window Length: 2000ms

BWC applied: 10.80 dB

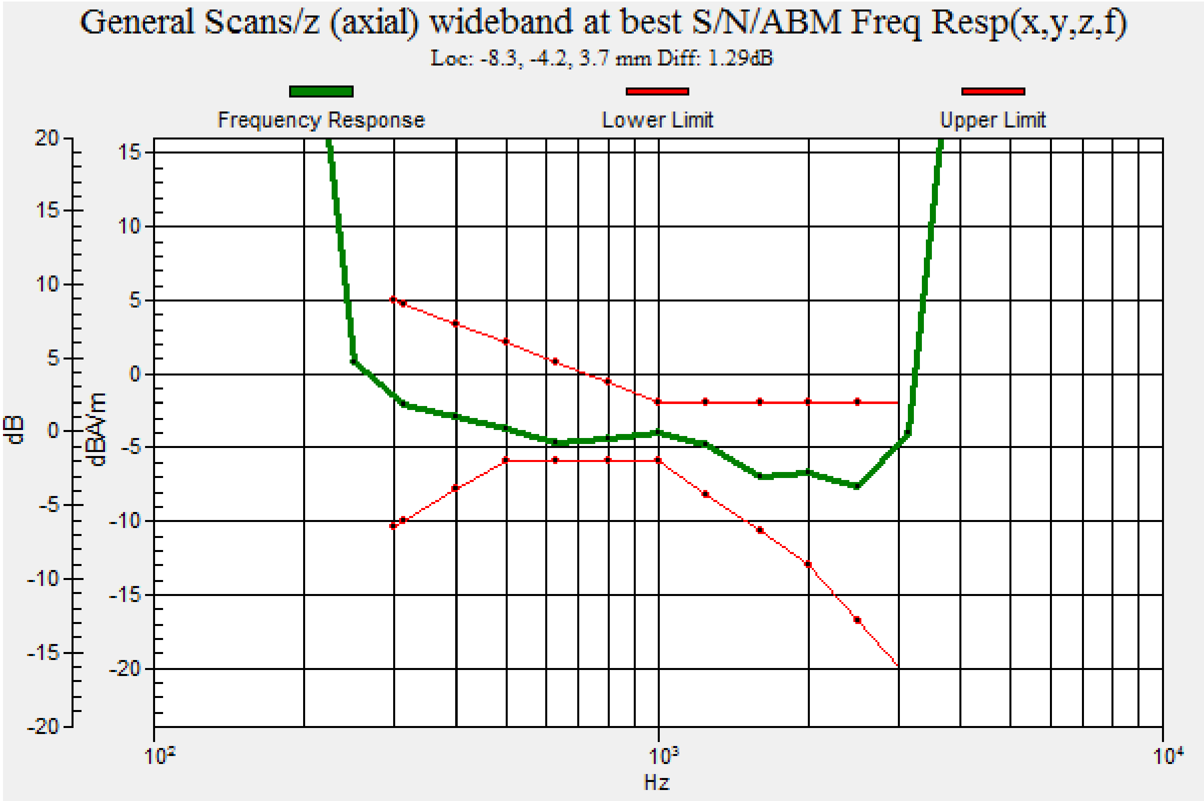
Device Reference Point: 0, 0, -6.3 mm

Cursor:

Diff = 1.29 dB

BWC Factor = 10.80 dB

Location: -8.3, -4.2, 3.7 mm



T-Coil LTE Band 12 Y transversal

Date: 5/20/2018

Communication System: UID 0, LTE (0); Frequency: 707.5 MHz;Duty Cycle: 1:1

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B12 HAC_TCoil_WD_Emission/General Scans/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

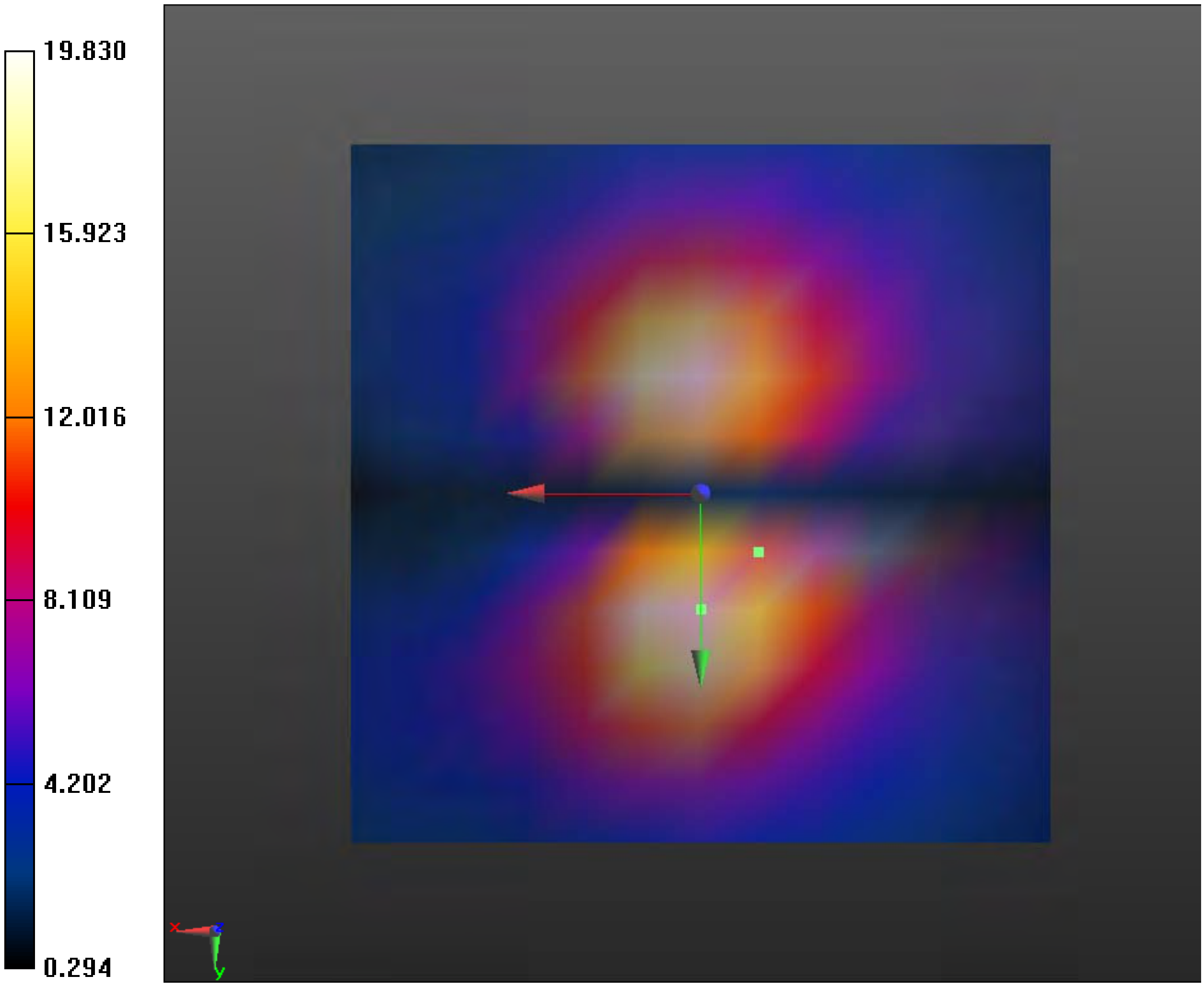
Cursor:

ABM1/ABM2 = 25.95 dB

ABM1 comp = -12.04 dBA/m

BWC Factor = 0.16 dB

Location: -4.2, 4.2, 3.7 mm



T-Coil LTE Band 12 Z Axial

Date: 5/20/2018

Communication System: UID 0, LTE (0); Frequency: 707.5 MHz;Duty Cycle: 1:1

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B12 HAC_TCoil_WD_Emission/General Scans/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

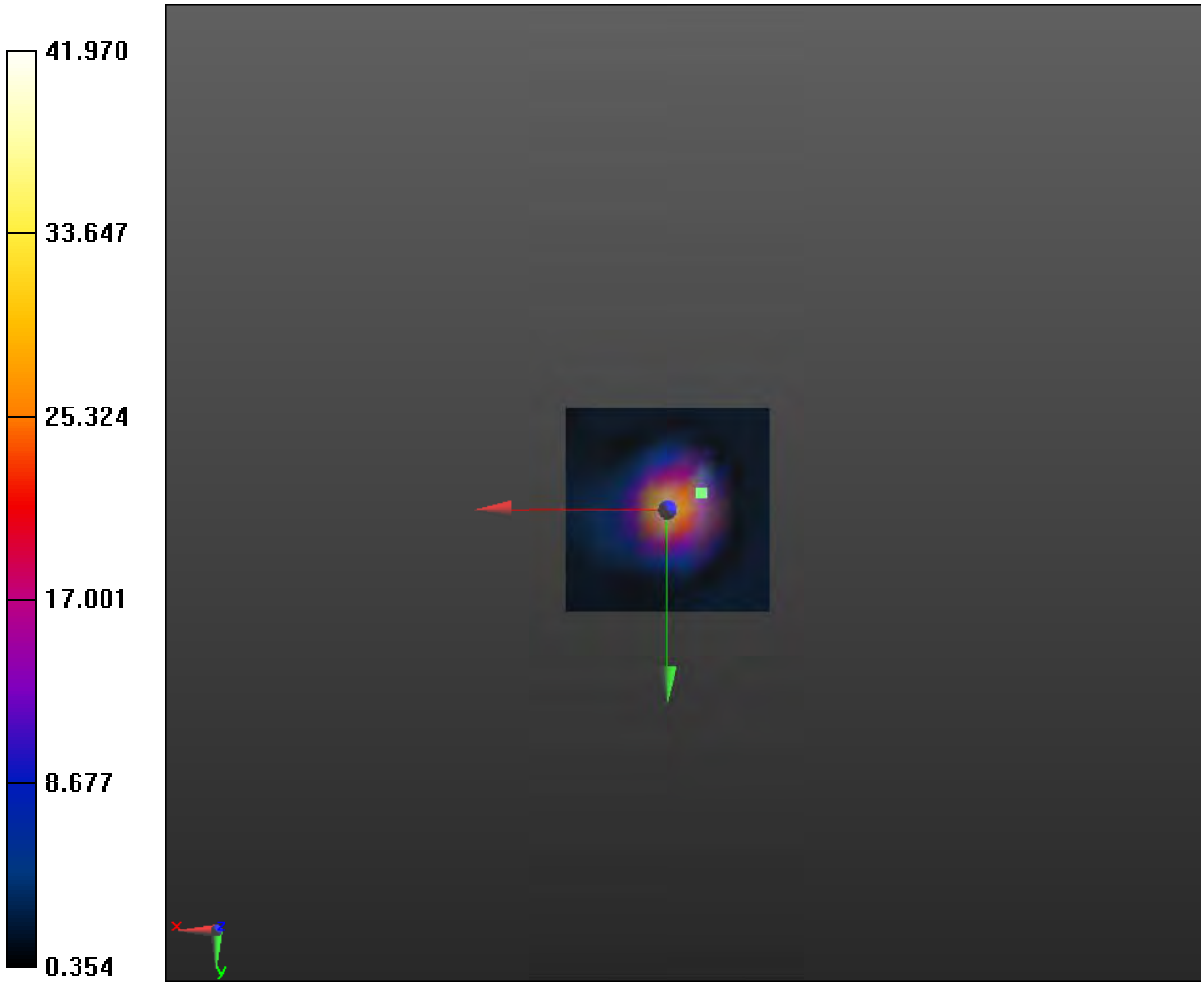
Cursor:

ABM1/ABM2 = 32.46 dB

ABM1 comp = -8.09 dBA/m

BWC Factor = 0.16 dB

Location: -8.3, -4.2, 3.7 mm



Coolpad 3310A LTE B12 HAC_TCoil_WD_Emission/General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav

Output Gain: 66.12

Measure Window Start: 300ms

Measure Window Length: 2000ms

BWC applied: 10.80 dB

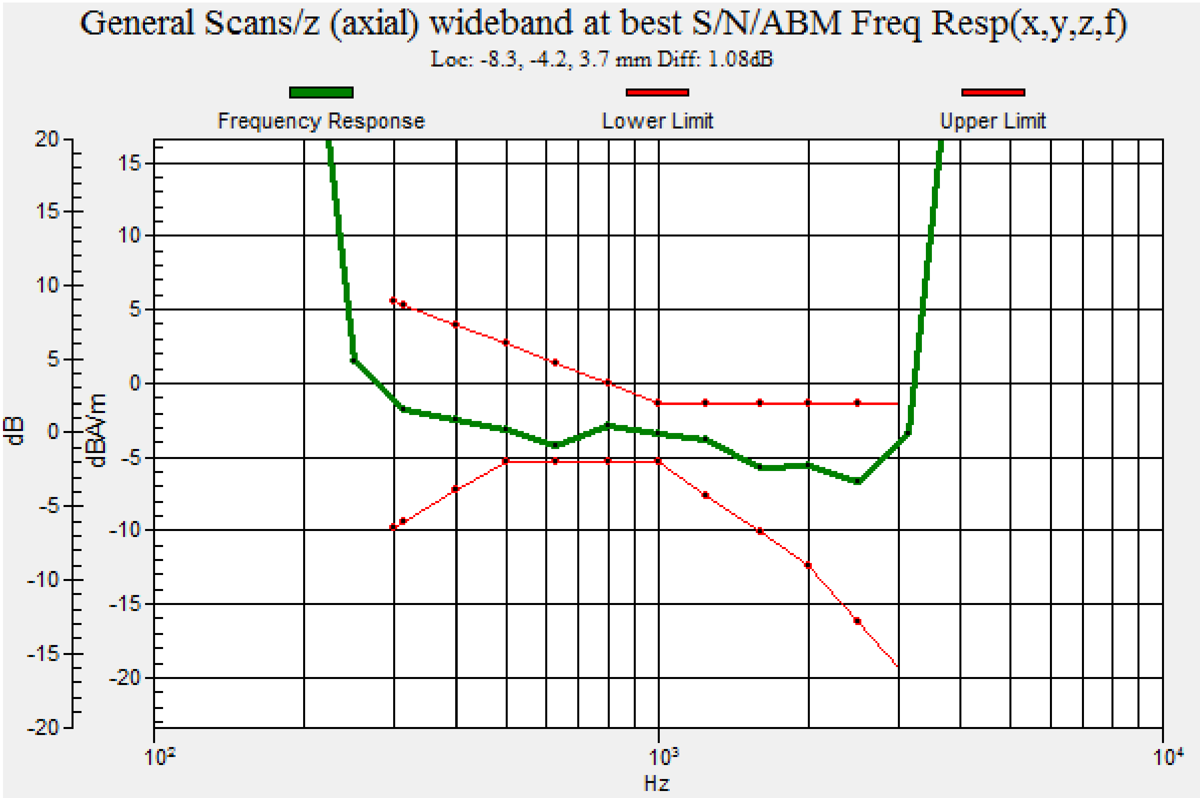
Device Reference Point: 0, 0, -6.3 mm

Cursor:

Diff = 1.08 dB

BWC Factor = 10.80 dB

Location: -8.3, -4.2, 3.7 mm



T-Coil LTE Band 13 Y transversal

Date: 5/20/2018

Communication System: UID 0, LTE (0); Frequency: 782 MHz;Duty Cycle: 1:1

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B13 HAC_TCoil_WD_Emission/General Scans/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

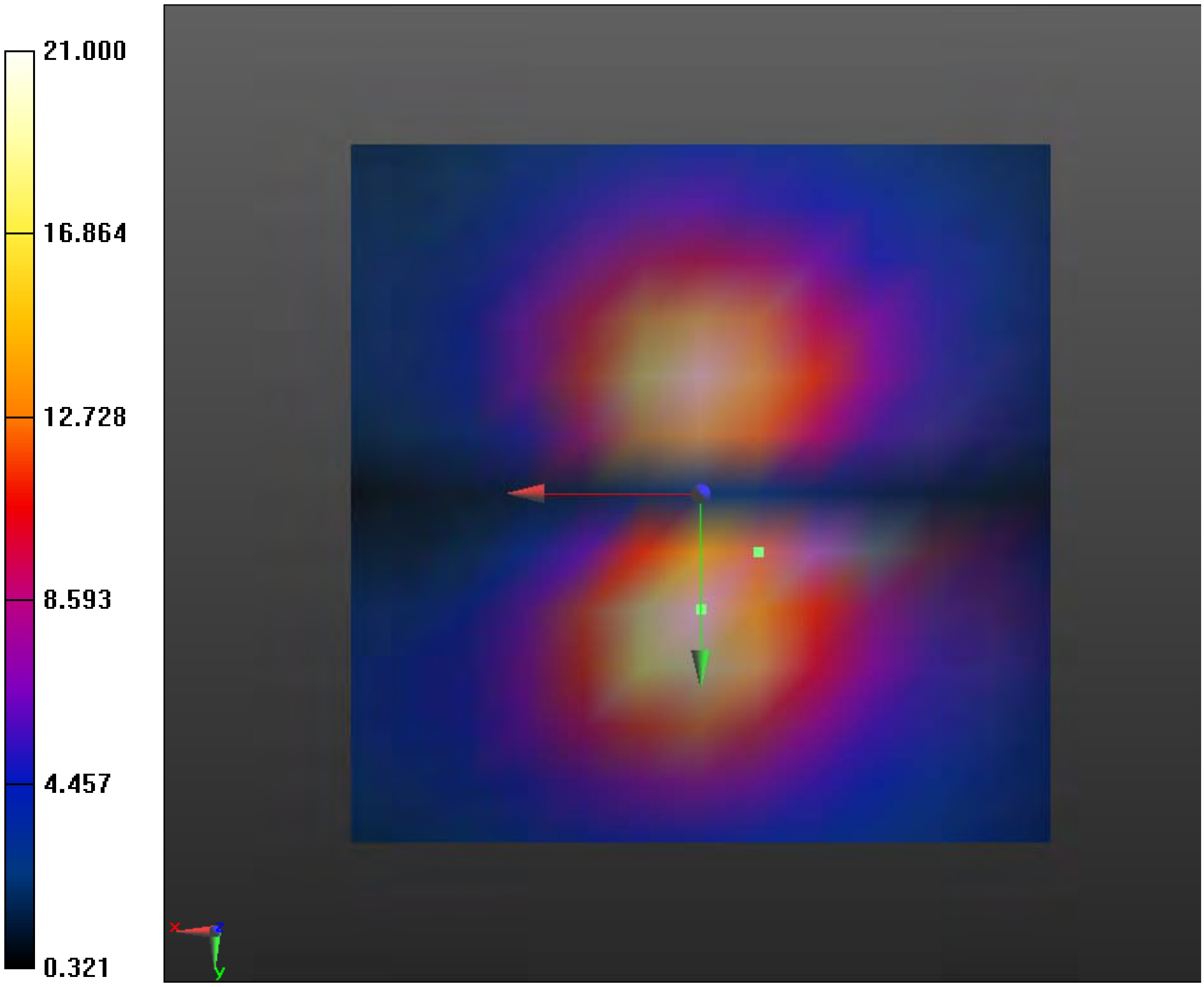
Cursor:

ABM1/ABM2 = 26.45 dB

ABM1 comp = -11.44 dBA/m

BWC Factor = 0.16 dB

Location: -4.2, 4.2, 3.7 mm



T-Coil LTE Band 13 Z Axial

Date: 5/20/2018
Communication System: UID 0, LTE (0); Frequency: 782 MHz;Duty Cycle: 1:1
Ambient Temperature:22.3 ℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 11/21/2017
Electronics: DAE4 Sn1291; Calibrated: 10/31/2017
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B13 HAC_TCoil_WD_Emission/General Scans/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 33.76
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.16 dB
Device Reference Point: 0, 0, -6.3 mm

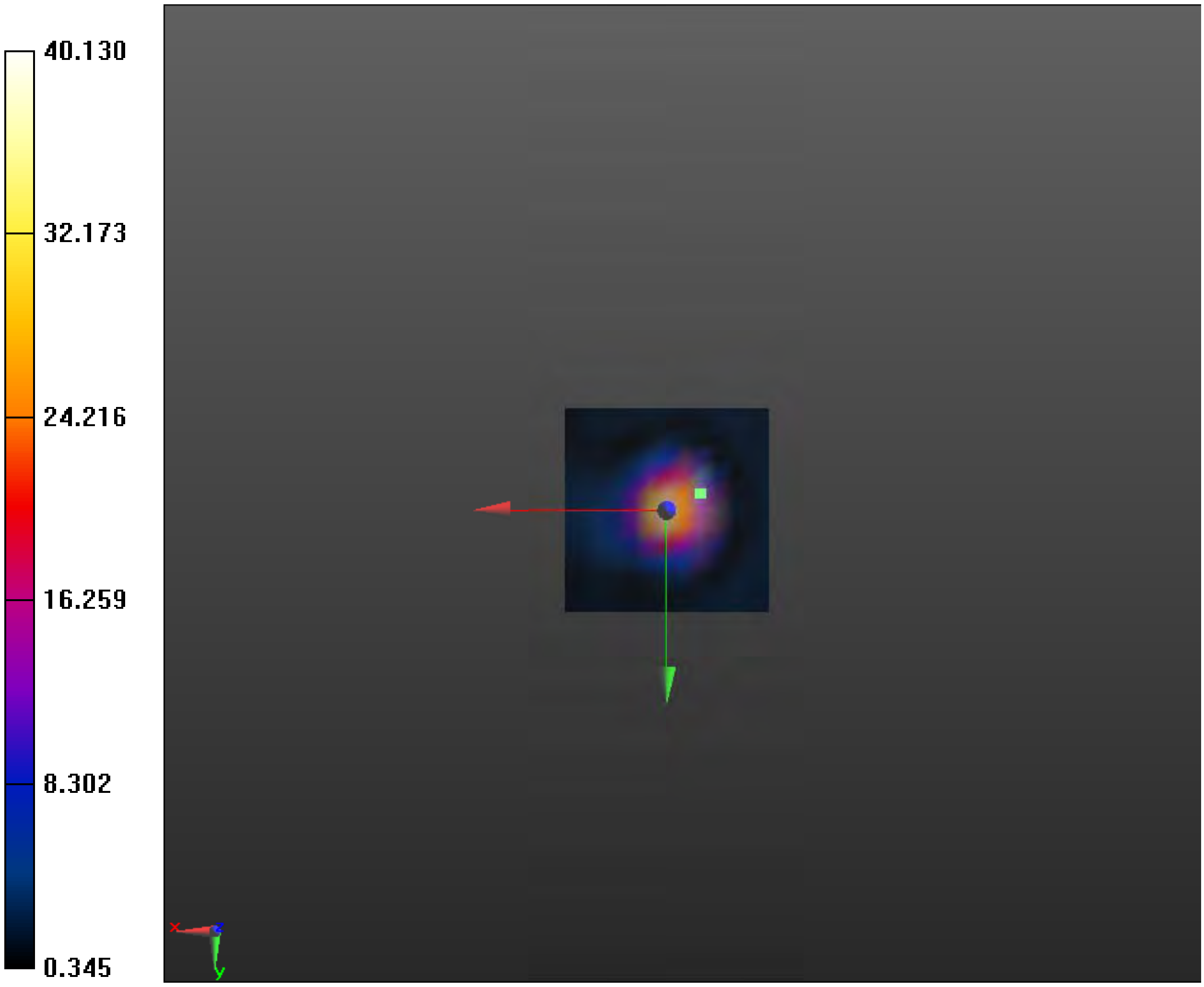
Cursor:

ABM1/ABM2 = 32.07 dB

ABM1 comp = -8.50 dBA/m

BWC Factor = 0.16 dB

Location: -8.3, -4.2, 3.7 mm



Coolpad 3310A LTE B13 HAC_TCoil_WD_Emission/General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav

Output Gain: 66.12

Measure Window Start: 300ms

Measure Window Length: 2000ms

BWC applied: 10.80 dB

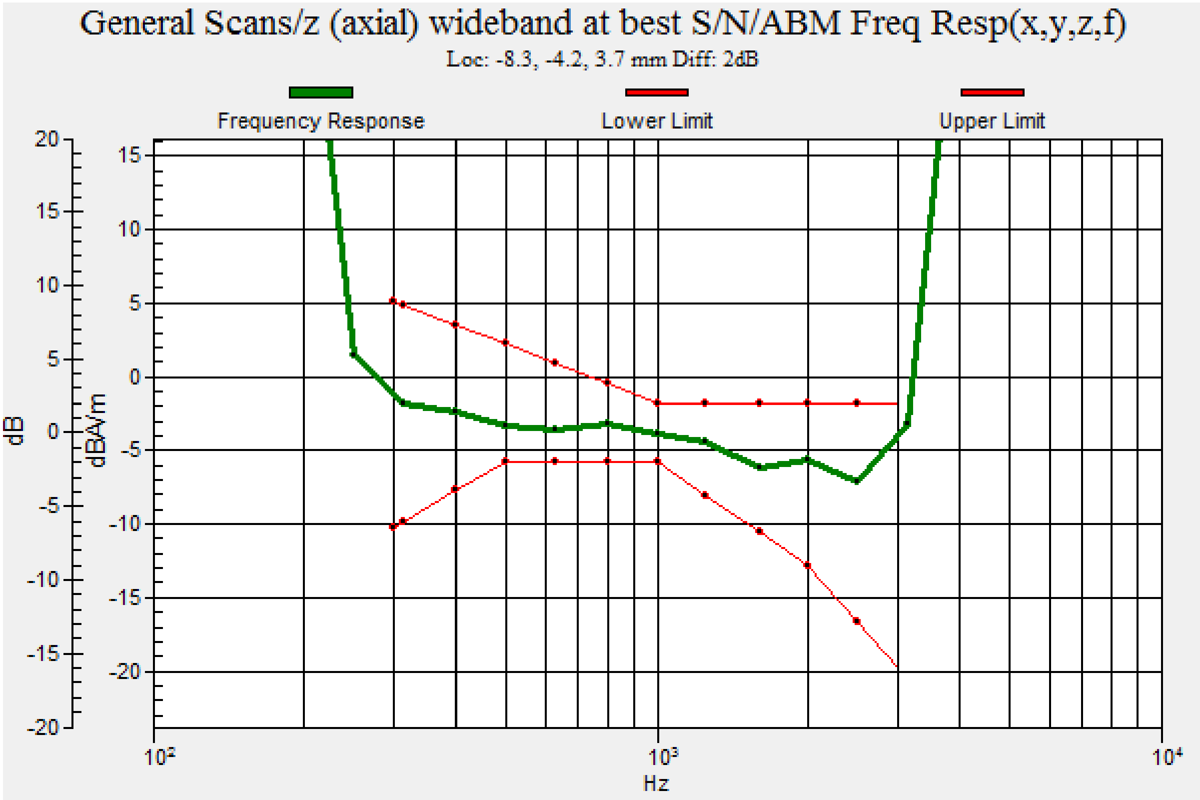
Device Reference Point: 0, 0, -6.3 mm

Cursor:

Diff = 2.00 dB

BWC Factor = 10.80 dB

Location: -8.3, -4.2, 3.7 mm



T-Coil LTE Band 25 Y transversal

Date: 6/12/2018
Communication System: UID 0, LTE (0); Frequency: 1882.5 MHz;Duty Cycle: 1:1
Ambient Temperature:22.3 ℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 4mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 11/21/2017
Electronics: DAE4 Sn1291; Calibrated: 10/31/2017
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B25 HAC_TCoil_WD_Emission/General Scans/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 33.76
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.16 dB
Device Reference Point: 0, 0, -6.3 mm

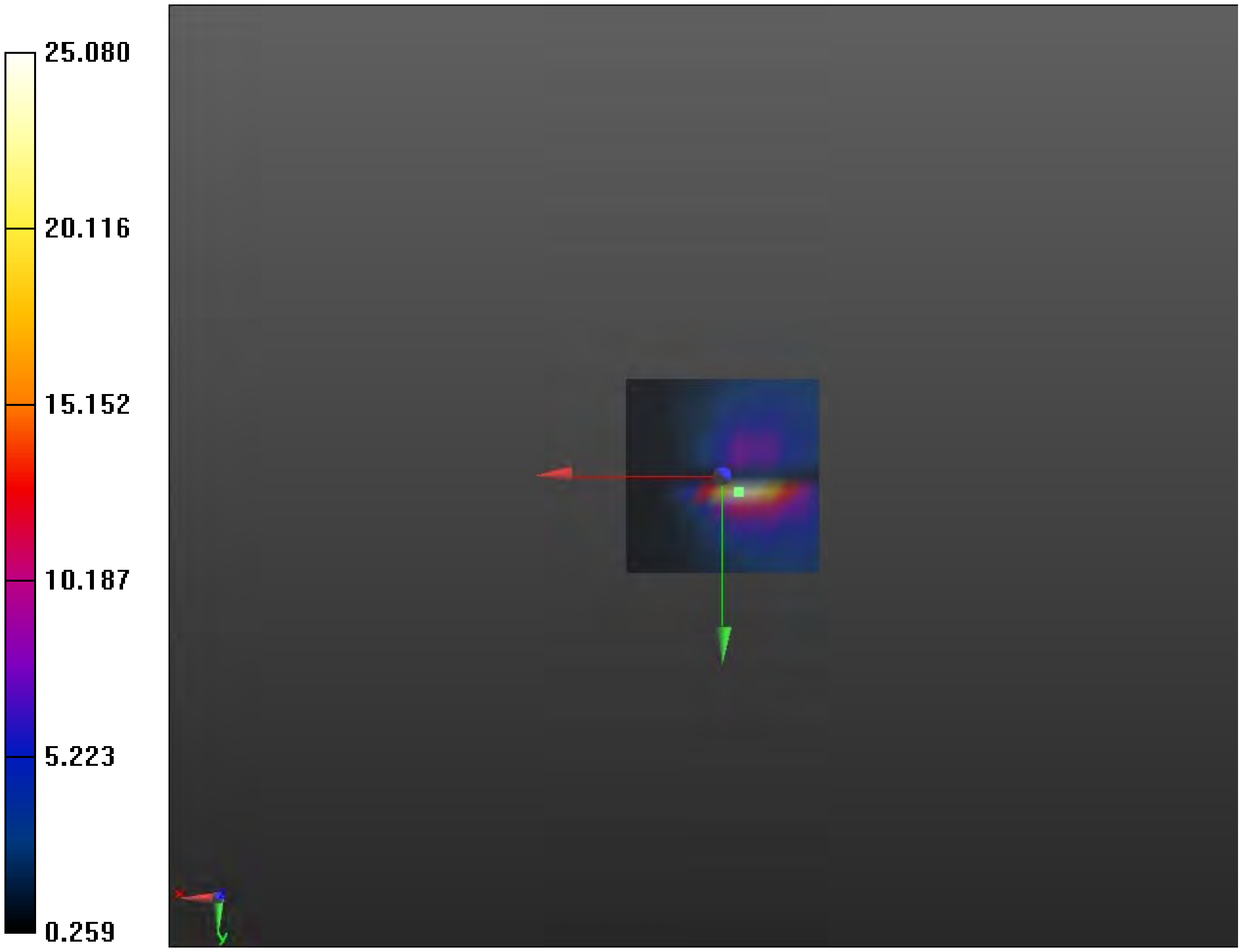
Cursor:

ABM1/ABM2 = 27.99 dB

ABM1 comp = -11.72 dBA/m

BWC Factor = 0.16 dB

Location: -4.2, 4.2, 3.7 mm



T-Coil LTE Band 25 Z Axial

Date: 6/12/2018

Communication System: UID 0, LTE (0); Frequency: 1882.5 MHz;Duty Cycle: 1:1

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B25 HAC_TCoil_WD_Emission/General Scans/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

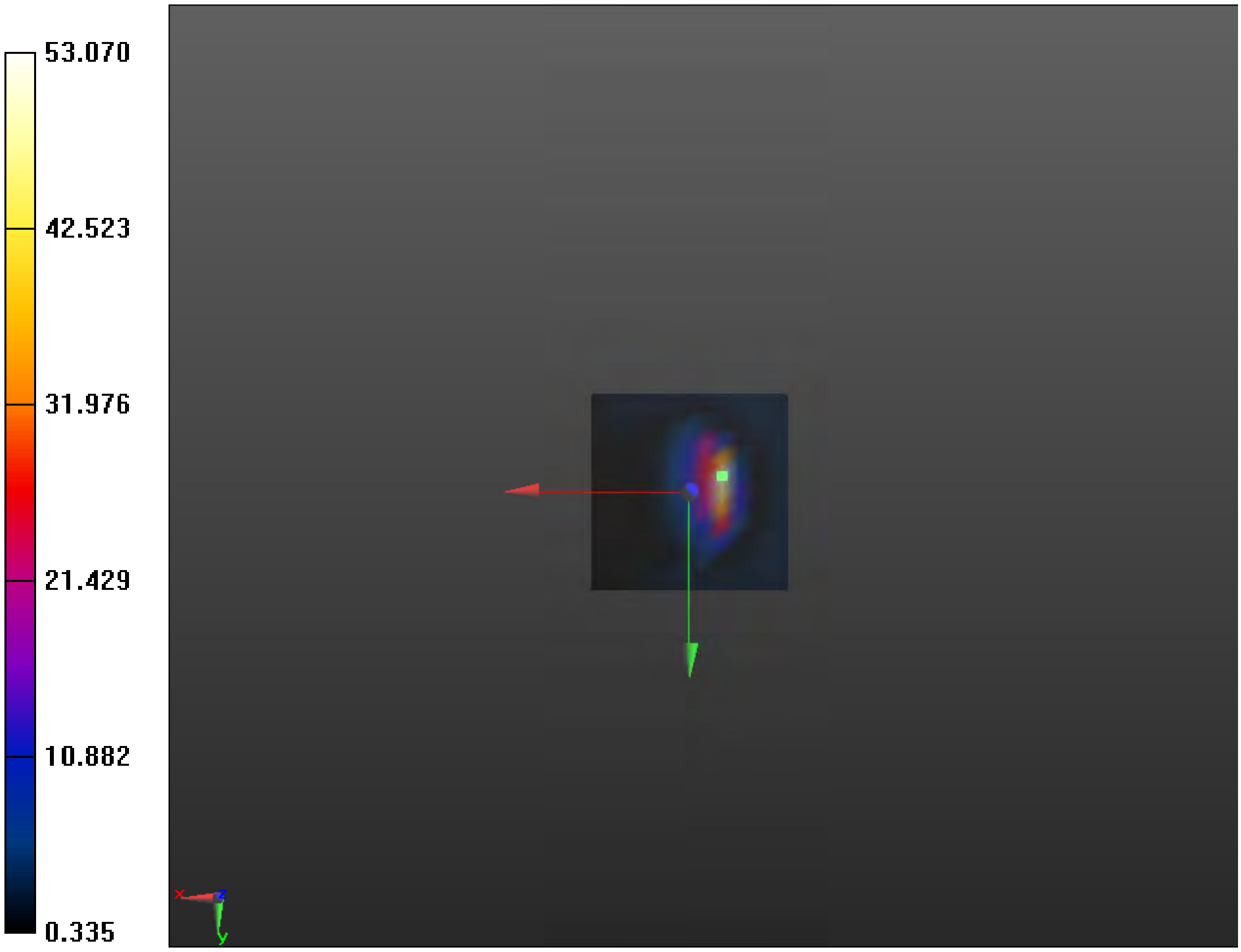
Cursor:

ABM1/ABM2 = 34.50 dB

ABM1 comp = -9.32 dBA/m

BWC Factor = 0.16 dB

Location: -8.3, -4.2, 3.7 mm



Coolpad 3310A LTE B25 HAC_TCoil_WD_Emission/General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav

Output Gain: 66.12

Measure Window Start: 300ms

Measure Window Length: 2000ms

BWC applied: 10.80 dB

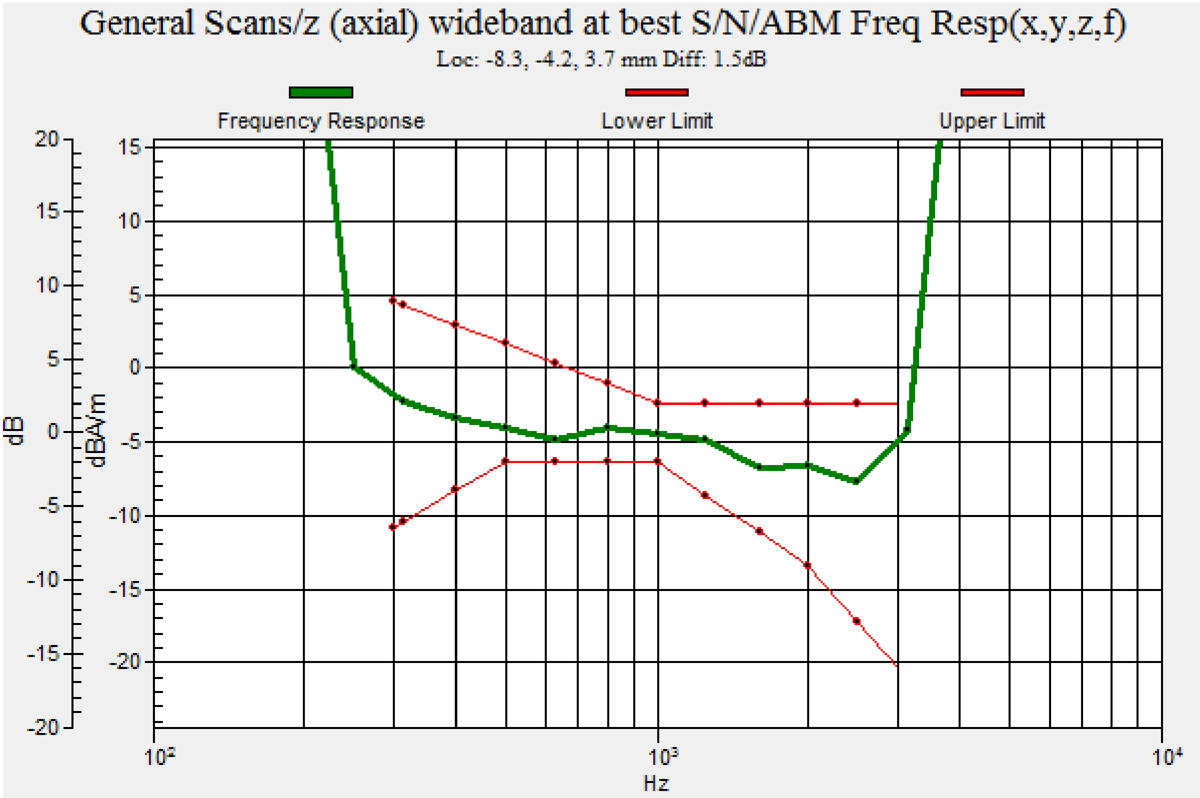
Device Reference Point: 0, 0, -6.3 mm

Cursor:

Diff = 1.50 dB

BWC Factor = 10.80 dB

Location: -8.3, -4.2, 3.7 mm



T-Coil LTE Band 26 Y transversal

Date: 5/20/2018

Communication System: UID 0, LTE (0); Frequency: 831.5 MHz;Duty Cycle: 1:1

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B26 HAC_TCoil_WD_Emission/General Scans/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

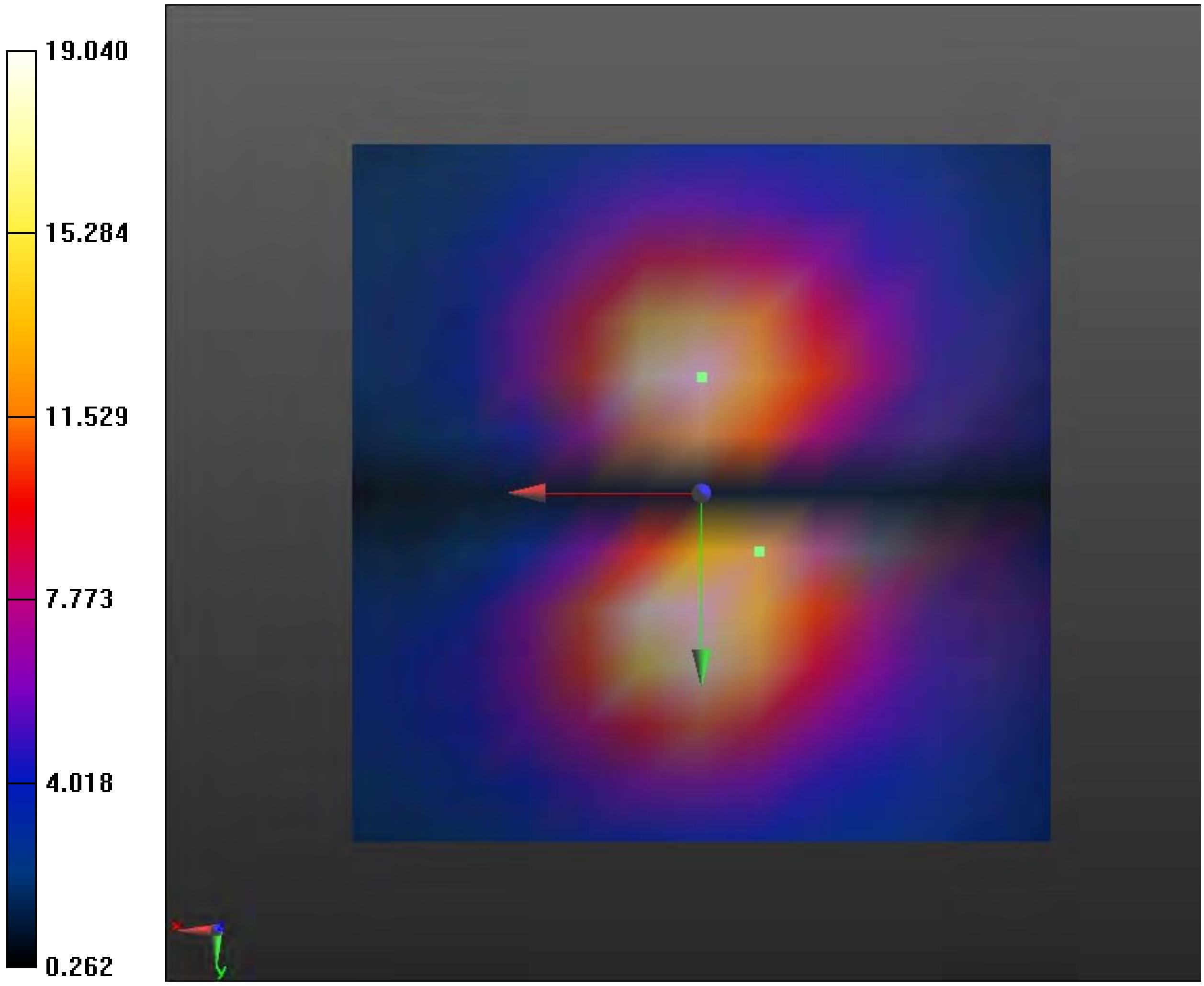
Cursor:

ABM1/ABM2 = 25.59 dB

ABM1 comp = -10.63 dBA/m

BWC Factor = 0.16 dB

Location: -4.2, 4.2, 3.7 mm



T-Coil LTE Band 26 Z Axial

Date: 5/20/2018

Communication System: UID 0, LTE (0); Frequency: 831.5 MHz;Duty Cycle: 1:1

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B26 HAC_TCoil_WD_Emission/General Scans/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

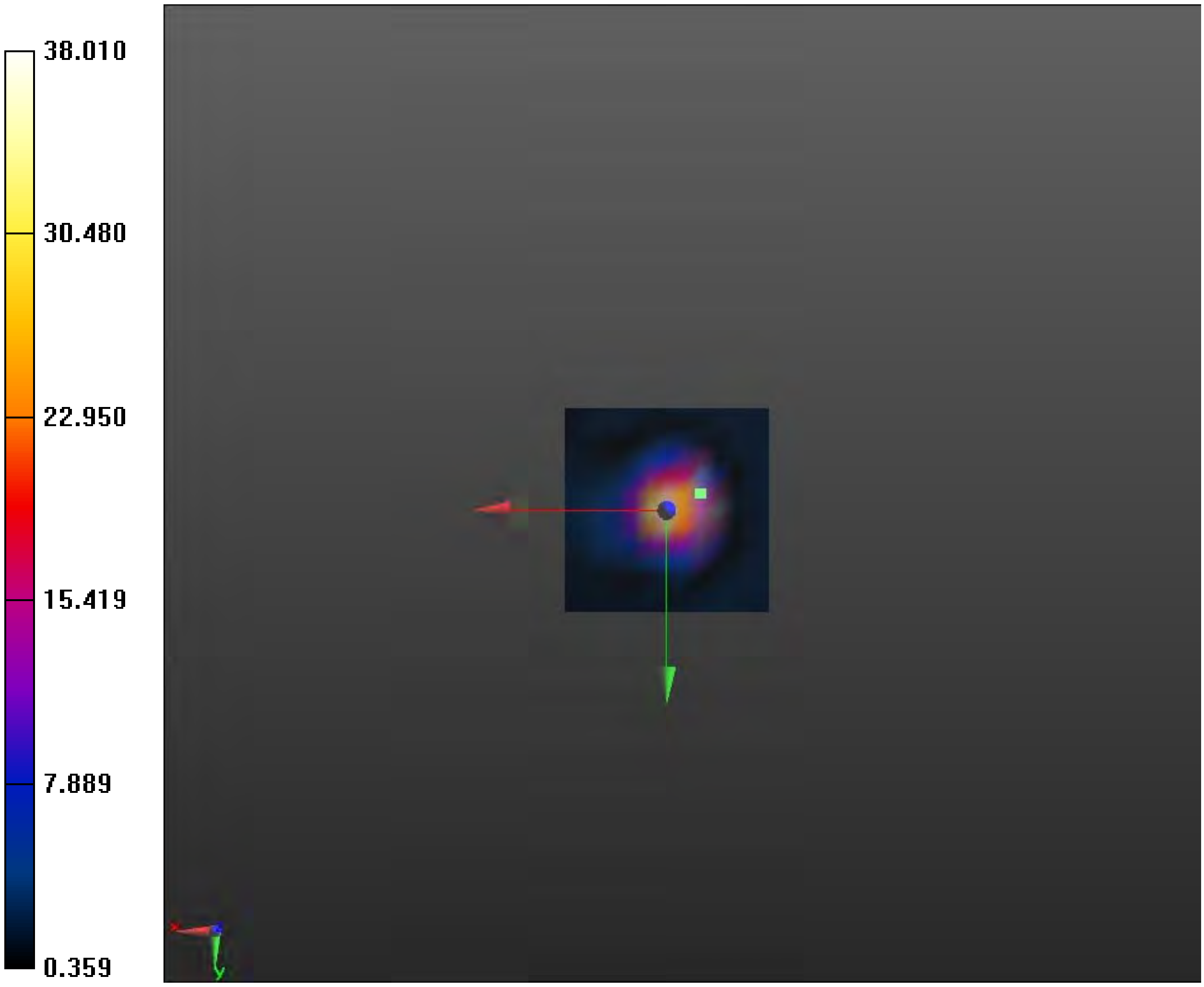
Cursor:

ABM1/ABM2 = 31.60 dB

ABM1 comp = -8.19 dBA/m

BWC Factor = 0.16 dB

Location: -8.3, -4.2, 3.7 mm



Coolpad 3310A LTE B26 HAC_TCoil_WD_Emission/General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav

Output Gain: 66.12

Measure Window Start: 300ms

Measure Window Length: 2000ms

BWC applied: 10.80 dB

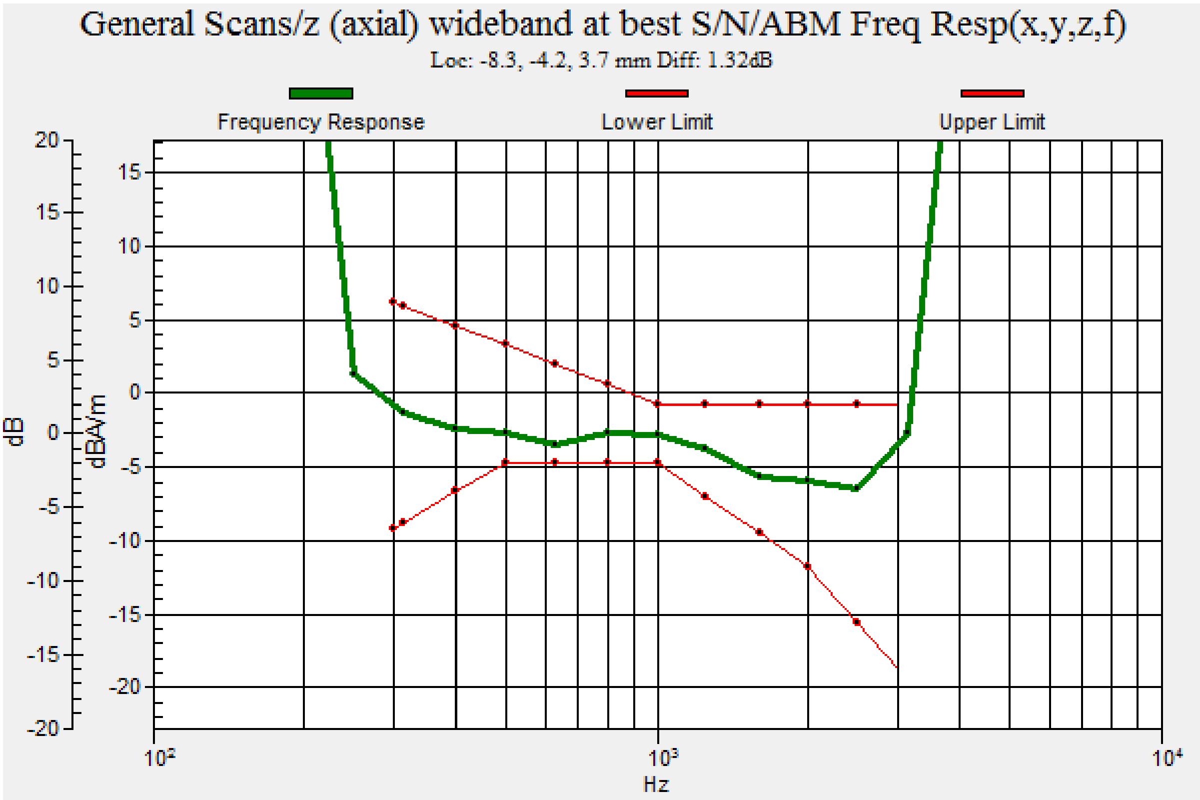
Device Reference Point: 0, 0, -6.3 mm

Cursor:

Diff = 1.32 dB

BWC Factor = 10.80 dB

Location: -8.3, -4.2, 3.7 mm



T-Coil LTE Band 41 Y transversal

Date: 5/20/2018
Communication System: UID 0, LTE (0); Frequency: 2593 MHz;Duty Cycle: 1:1.58
Ambient Temperature:22.3 ℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 11/21/2017
Electronics: DAE4 Sn1291; Calibrated: 10/31/2017
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B41 HAC_TCoil_WD_Emission/General Scans/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 33.76
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.16 dB
Device Reference Point: 0, 0, -6.3 mm

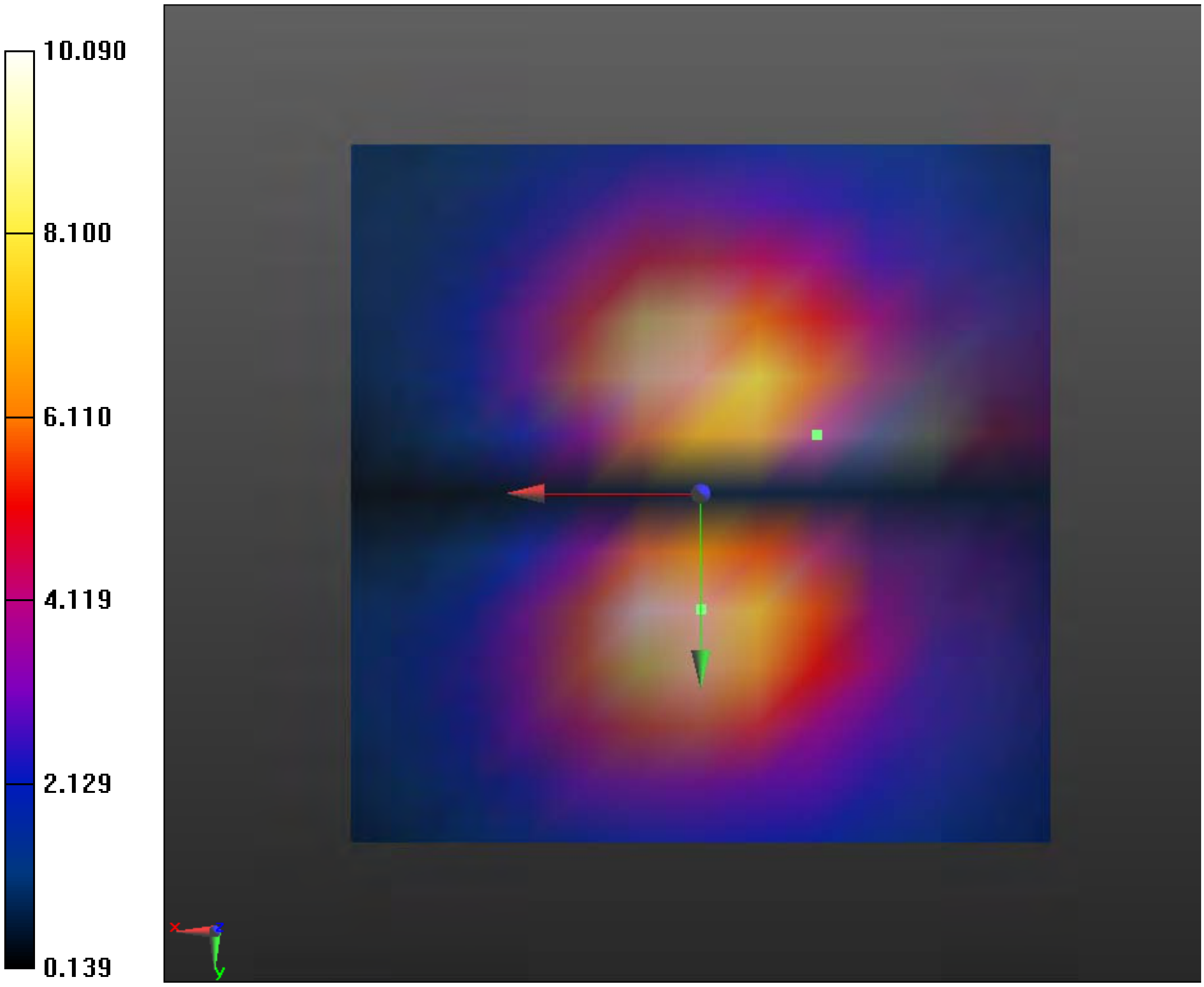
Cursor:

ABM1/ABM2 = 20.08 dB

ABM1 comp = -14.62 dBA/m

BWC Factor = 0.16 dB

Location: -8.3, -4.2, 3.7 mm



T-Coil LTE Band 41 Z Axial

Date: 5/20/2018

Communication System: UID 0, LTE (0); Frequency: 2593 MHz;Duty Cycle: 1:1.58

Ambient Temperature:22.3 ℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 11/21/2017

Electronics: DAE4 Sn1291; Calibrated: 10/31/2017

Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Coolpad 3310A LTE B41 HAC_TCoil_WD_Emission/General Scans/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm

Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav

Output Gain: 33.76

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

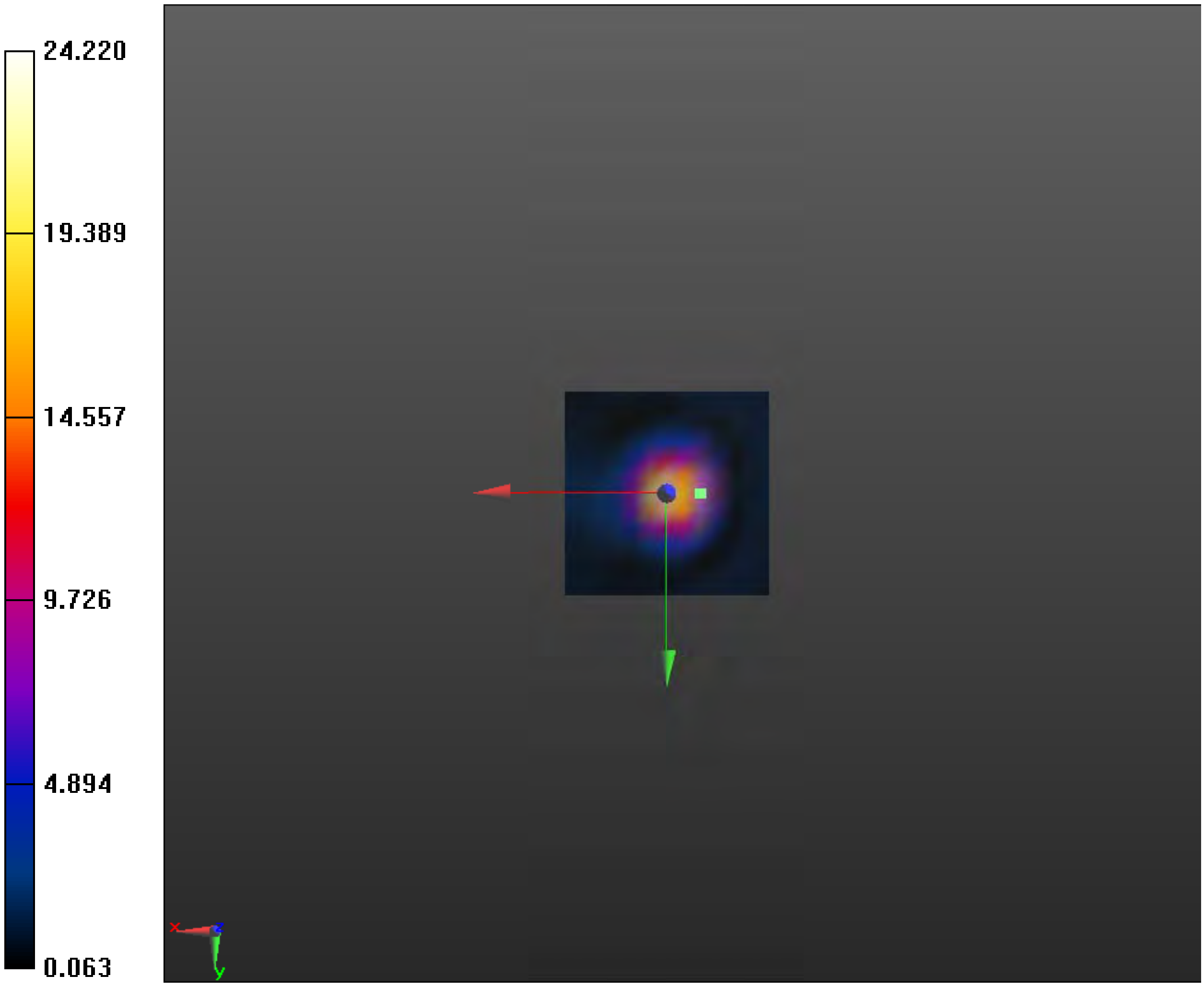
Cursor:

ABM1/ABM2 = 27.68 dB

ABM1 comp = -6.94 dBA/m

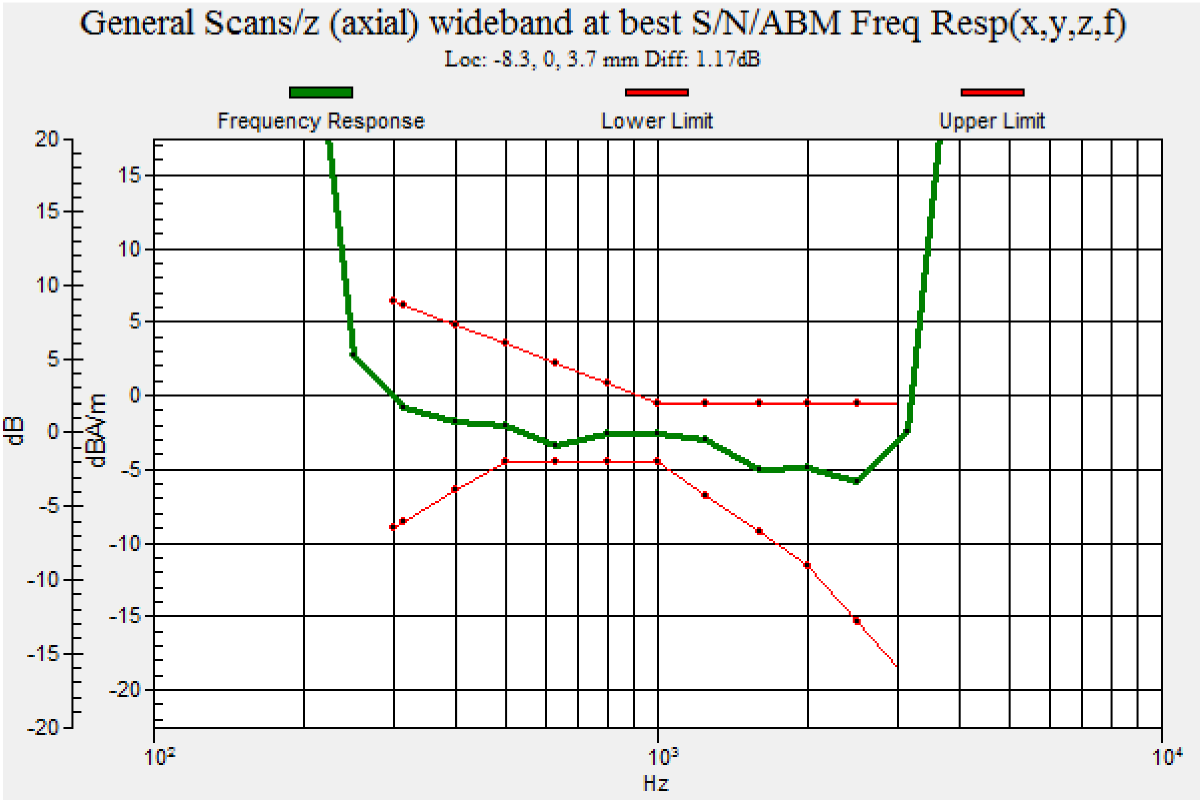
BWC Factor = 0.16 dB

Location: -8.3, 0, 3.7 mm



Coolpad 3310A LTE B41 HAC_TCoil_WD_Emission/General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_300-3000_2s.wav
Output Gain: 66.12
Measure Window Start: 300ms
Measure Window Length: 2000ms
BWC applied: 10.80 dB
Device Reference Point: 0, 0, -6.3 mm

Cursor:
Diff = 1.17 dB
BWC Factor = 10.80 dB
Location: -8.3, 0, 3.7 mm



ANNEX C: Probe Calibration Certificate

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

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

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

Accreditation No.: SCS 0108

Client TA-SH (Auden) **Certificate No: AM1DV3-3082_Nov17**

CALIBRATION CERTIFICATE

Object	AM1DV3 - SN: 3082
Calibration procedure(s)	QA CAL-24.v4 Calibration procedure for AM1D magnetic field probes and TMFS in the audio range
Calibration date:	November 21, 2017

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	31-Aug-17 (No. 21092)	Aug-18
Reference Probe AM1DV2	SN: 1008	30-Dec-16 (No. AM1D-1008_Dec16)	Dec-17
DAE4	SN: 781	13-Jul-17 (No. DAE4-781_Jul17)	Jul-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
AMCC	SN: 1050	01-Oct-13 (in house check Oct-17)	Oct-19
AMMI Audio Measuring Instrument	SN: 1062	26-Sep-12 (in house check Oct-17)	Oct-19

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	[signature]
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: November 21, 2017

Certificate No: AM1DV3-3082_Nov17 Page 1 of 3

[References

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

[2] ANSI-C63.19-2011
American National Standard, Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

[3] DASY5 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+2]. 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+2] 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 [3], 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.

Certificate No: AM1DV3-3082_Nov17 Page 2 of 3

AM1D probe identification and configuration data

Item	**AM1DV3** Audio Magnetic 1D Field Probe
Type No	SP AM1 001 BA
Serial No	**3082**

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	May 28, 2010
Last calibration date	November 23, 2016

Calibration data

Connector rotation angle	(in DASY system)	**2.4 °**	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	**0.69 °**	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	**0.00739 V / (A/m)**	+/- 2.2 % (k=2)

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

ANNEX D: DAE4 Calibration Certificate

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

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

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

Accreditation No.: **SCS 0108**

Client **TA-SH (Auden)**

Certificate No: **DAE4-1291_Oct17**

CALIBRATION CERTIFICATE

Object: DAE4 - SD 000 D04 BM - SN: 1291

Calibration procedure(s): QA CAL-06.v29
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: October 31, 2017

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	31-Aug-17 (No:21092)	Aug-18
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-17 (in house check)	In house check: Jan-18
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-17 (in house check)	In house check: Jan-18

	Name	Function	Signature
Calibrated by:	Eric Hainfeld	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	i.V.

Issued: October 31, 2017

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

Certificate No: DAE4-1291_Oct17 Page 1 of 5

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

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

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

Accreditation No.: **SCS 0108**

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 = 6.1μV , 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	402.531 ± 0.02% (k=2)	403.204 ± 0.02% (k=2)	403.118 ± 0.02% (k=2)
Low Range	3.97419 ± 1.50% (k=2)	3.97827 ± 1.50% (k=2)	3.97437 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	309.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200033.09	-1.13	-0.00
Channel X	+ Input	20005.24	0.43	0.00
Channel X	- Input	-20002.50	2.70	-0.01
Channel Y	+ Input	200031.52	-2.54	-0.00
Channel Y	+ Input	20002.99	-1.90	-0.01
Channel Y	- Input	-20005.78	-0.47	0.00
Channel Z	+ Input	200033.14	-0.98	-0.00
Channel Z	+ Input	20001.98	-2.75	-0.01
Channel Z	- Input	-20006.08	-0.65	0.00

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.76	0.75	0.04
Channel X	+ Input	201.56	0.40	0.20
Channel X	- Input	-198.62	0.27	-0.14
Channel Y	+ Input	2001.35	0.49	0.02
Channel Y	+ Input	202.20	1.16	0.57
Channel Y	- Input	-200.25	-1.24	0.62
Channel Z	+ Input	2000.49	-0.37	-0.02
Channel Z	+ Input	200.01	-0.98	-0.49
Channel Z	- Input	-200.38	-1.21	0.61

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	9.58	7.76
	- 200	-6.07	-8.06
Channel Y	200	13.34	13.80
	- 200	-15.13	-15.41
Channel Z	200	-16.12	-16.97
	- 200	14.39	14.53

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	-	0.30	-3.79
Channel Y	200	6.95	-	0.36
Channel Z	200	10.83	4.52	-

Certificate No: DAE4-1291_Oct17 Page 4 of 5

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	16119	16474
Channel Y	15930	16813
Channel Z	16170	16434

5. Input Offset Measurement

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

Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.93	-0.36	2.05	0.49
Channel Y	-0.05	-1.46	0.88	0.48
Channel Z	-1.03	-2.76	1.81	0.59

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

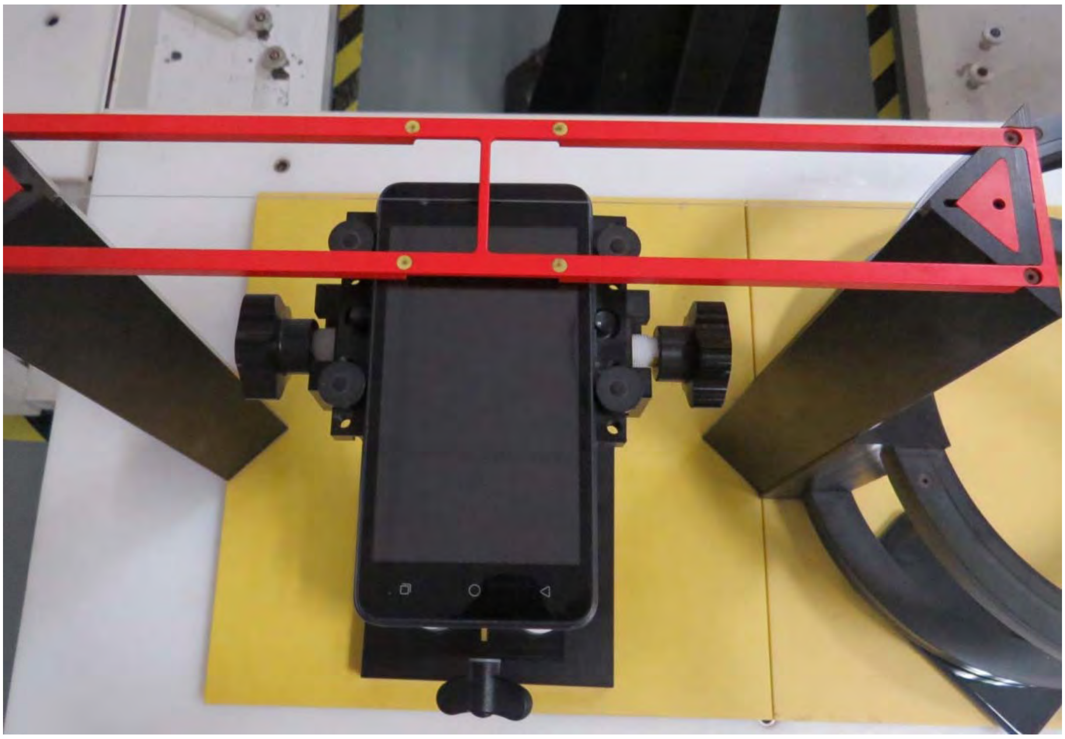
9. Power Consumption (Typical values for information)

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

ANNEX E: The EUT Appearances and Test Configuration

a: EUT

Picture 2: Constituents of EUT



Picture 3: Test Setup