HAC TEST REPORT

Applicant	Excellus Communications, LLC
FCC ID	2AW56-EZFLIP2
Product	4G senior phone
Brand	Snapfon
Model	Snapfon ezFlip 4G v1.1
Report No.	R2112A1184-H2
Issue Date	July 13, 2022

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.

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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

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 measurements.

A2LA (Certificate Number: 3857.01)

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

1.2 Testing Location

Company:	TA Technology (Shanghai) Co., Ltd.
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1.3 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
GSM 850	T4
GSM 1900	T4
WCDMA Band II	T4
WCDMA Band IV	T4
WCDMA Band V	T4
LTE Band 2	T4
LTE Band 4	T4
LTE Band 5	T4
LTE Band 12	T4
LTE Band 66	T4
The Total T-Coil rating is T4	
Date of Testing: December 30, 2022 ~ July 11, 2022	
Date of Sample Receiving: December 27, 2021	
Note: LTE and Wi-Fi mode do not support voice function. All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.	

3 Description of Equipment under Test

Client Information

Applicant	Excellus Communications, LLC
Applicant address	27298 Wetland Road, Suite 101 Harrisburg, SD 57032 USA
Manufacturer	Ying Tai Electronics Co., Ltd
Manufacturer address	ROOM 803, CHEVALIER HOUSE 45-51 CHATHAM ROAD SOUTH, TSIM SHA TSUI, KOWLOON, HONG KONG

General Technologies

Device Type:	Portable Device	
EUT Stage	Production Unit	
Model	Snapfon ezFlip 4G v1.1	
IMEI:	358294087828981	
Hardware Version	P31-MB-V1.2	
Software Version	Snapfon_ezFlip_V2.0_20210929_1457	
Antenna Type	PIFA Antenna	
Power Class:	GSM 850: 4 GSM 1900: 1 WCDMA Band II/IV/V: 3 LTE FDD 2/4/5/12/66: 3	
Power Level	GSM 850: level 5 GSM 1900: level 0 WCDMA Band II/IV/V: All up bits LTE FDD 2/4/5/12/66: max power	
Test Modulation:	(GSM)GMSK; (WCDMA) QPSK; (LTE) QPSK, 16QAM;	
Operating Frequency Range(s):	Mode	Tx (MHz)
	GSM 850	824 ~ 849
	GSM 1900	1850 ~ 1910
	WCDMA Band II	1850 ~ 1910
	WCDMA Band IV	1710 ~ 1755
	WCDMA Band V	824 ~ 849
	LTE FDD 2	1850 ~ 1910
	LTE FDD 4	1710 ~ 1755
	LTE FDD 5	824 ~ 849
	LTE FDD 12	699 ~ 716
	LTE FDD 66	1710 ~ 1780
	BT	2402 ~2480
Accessory Equipment		
Battery	Manufacturer: Shenzhen Changxingda New Energy CO.,Ltd.	

	Model: BT02
Adapter	Manufacturer: Shenzhen huajin electronics co., LTD Model: HJ-0501000E1-US
Note: The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant.	

Air-Interface	Band (MHz)	Type	ANSI C63.19 tested	Simultaneous Transmissions	Voice over Digital Transport OTT Capability	Name of Voice Service	Power Reduction
GSM	850	VO	Yes	Yes BT	N/A	#	No
	1900						
	GPRS/EGPRS	DT	No		No		
WCDMA	Band II	VO	Yes	Yes BT	N/A	#	No
	Band IV						
	Band V						
	HSPA	DT	No		No		
LTE	Band 2	VD	Yes	Yes BT	No	Yes##	No
	Band 4						
	Band 5						
	Band 12						
	Band 66						
Bluetooth (BT)	2450	DT	No	Yes GSM, WCDMA, LTE	N/A	NA	No

VO= legacy Cellular Voice Service from Table 7.1 in 7.4.2.1 of ANSI C63.19-2011
VD= IP voice service over digital transport.
DT= Digital Transport only (no voice)
#: Ref Lev in accordance with 7.4.2.1 of ANSI C63.19-2011
##: Ref Lev in accordance with the July 2012 VoLTE interpretation.

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
KDB 285076 D01 HAC Guidance v05r01
KDB 285076 D02 T-Coil Testing v03r01

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.

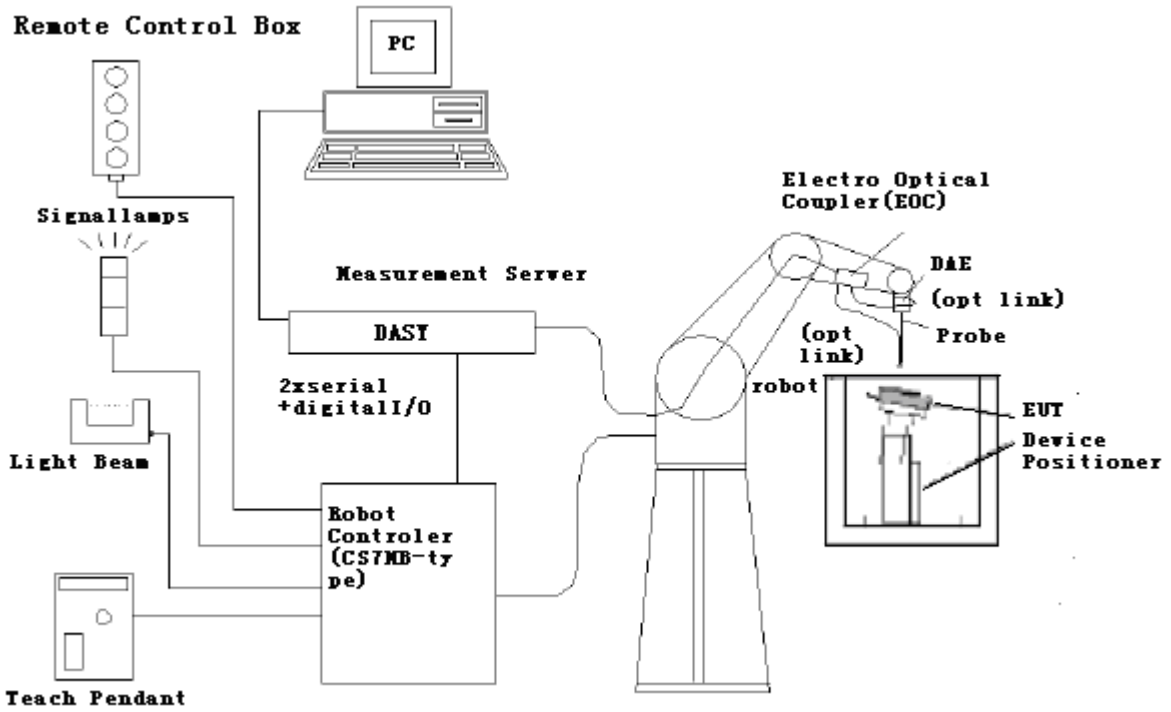


Figure 1 T-Coil Test Measurement Set-up

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.

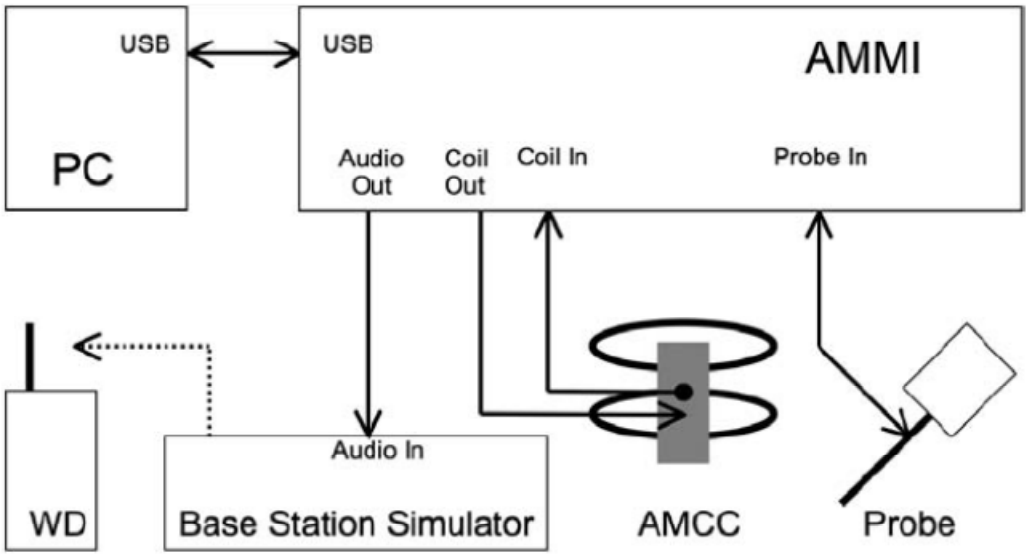


Figure 2 T-Coil Test Measurement Set-up

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

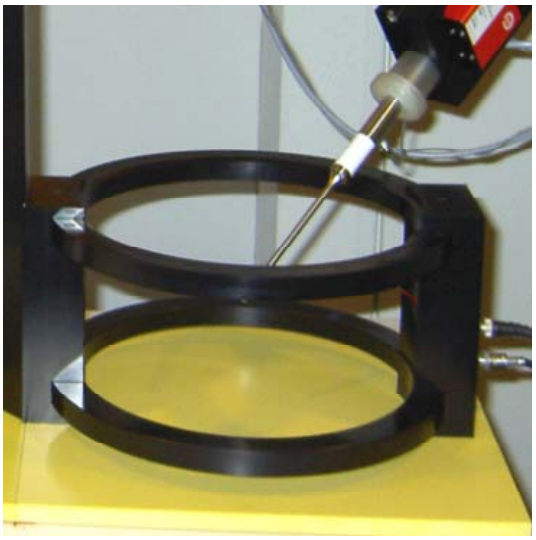


Figure 6 AMCC

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.

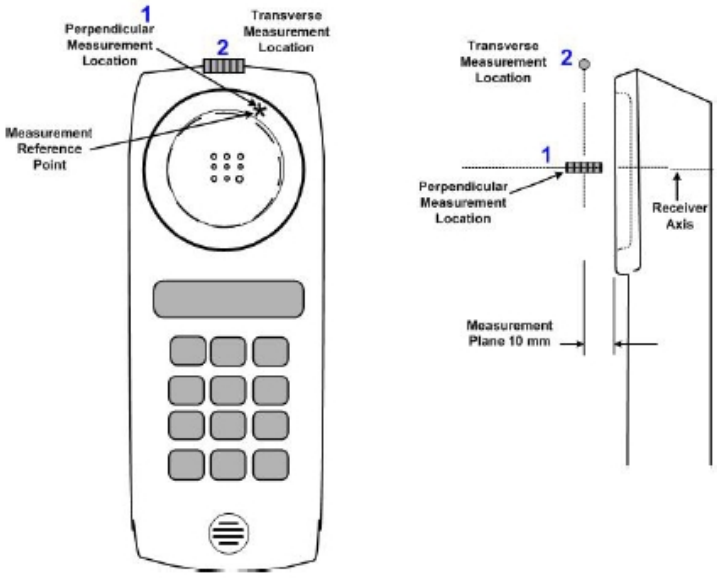


Figure 8 Axis and planes for EUT audio frequency magnetic field measurements

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

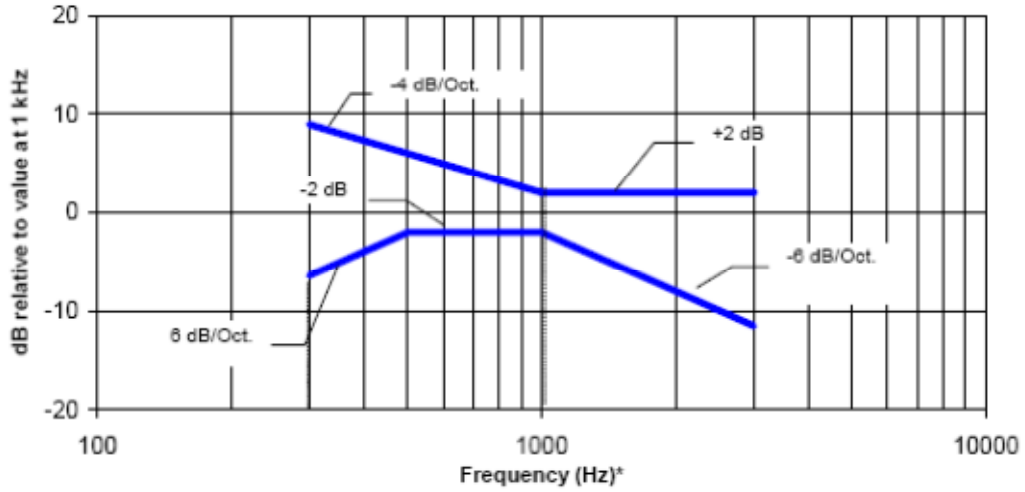
In order to be rated for T-Coil use, a EUT shall meet the requirements for signal level and signal quality contained in this part.

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.

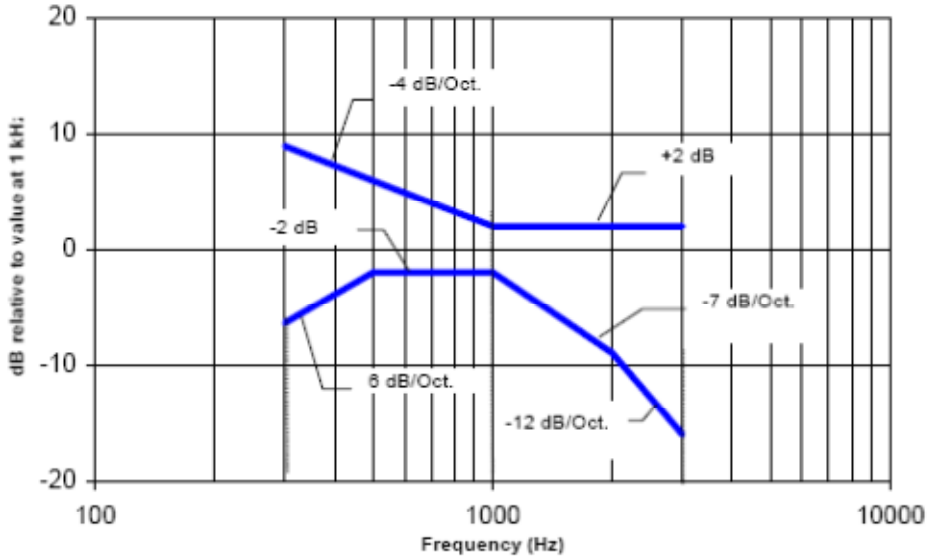
6.2 Frequency response

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

7 T-Coil testing for WCDMA

1. Codec investigation

An investigation was performed to determine the audio codec to be used for testing by SNR comparison. The AMR 12.2kbps setting was used for the testing as the worst-case codec.

Codec Investigation - WCDMA									
Codec Setting	AMR -NB			AMR -WB			Orientation	Band	Channel
	AMR 12.2kbps	AMR 7.4kbps	AMR 4.75kbps	AMR 23.85kbps	AMR 15.85kbps	AMR 6.6kbps			
ABM1 (dBA/m)	-1.30	-2.04	-1.53	1.49	1.67	1.97	z (Axial):	Band II	9400
ABM2 (dBA/m)	-53.21	-54.39	-54.36	-53.32	-53.37	-53.3			
Frequency Response	Pass	Pass	Pass	Pass	Pass	Pass			
Signal Quality (dB)	**51.91**	52.35	52.83	54.81	55.04	55.27			

2. Air Interface Investigation

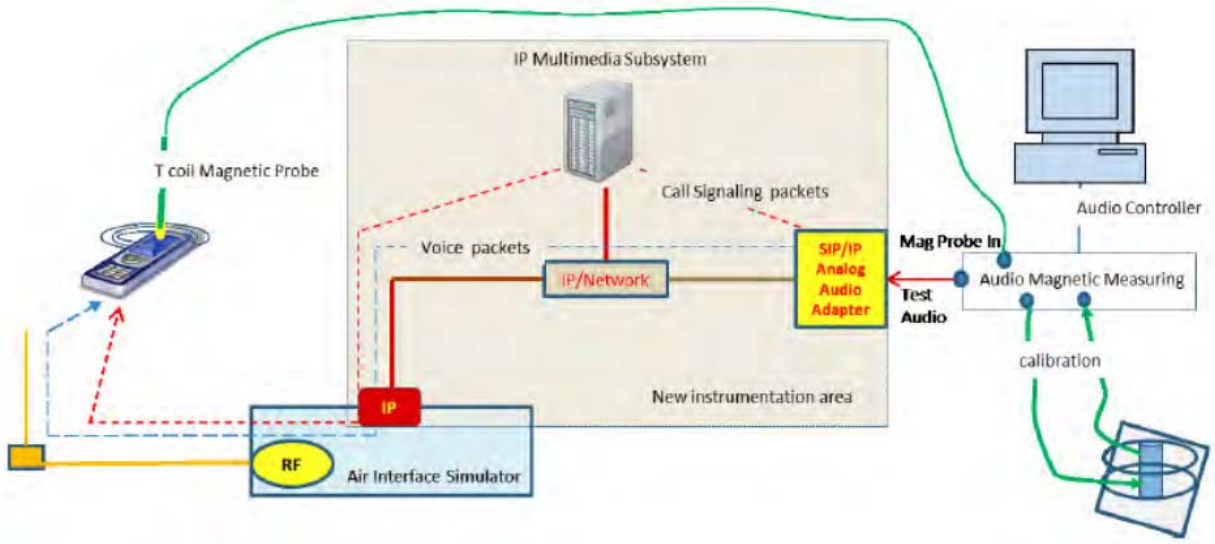
Using the worst case codec to test low/middle/high channels in each band.

8 T-Coil testing for VoLTE

I. Test setup for VoLTE over IMS T-coil Testing

1. Test setup

The general test setup used for VoLTE over IMS is shown below. The call box used when performing VoLTE over IMS T-coil measurement is a CMW500. The Data Application Unit (DAU) of the CMW500 was used to simulate the IP Multimedia Subsystem (IMS) server.



2. Audio level setting

According to the July 2012 interpretations by the C63 Committee regarding the appropriate audio levels to be used for VoLTE over IMS T-coil testing, -16dBm0 shall be used for the nomal speech input level. The CMW500 base station simulator was manually configured to ensure that the settings for speech input and full scale levels resulted in the -16dBm0 speech input level to the DUT for the VoLTE over IMS connection.

II. DUT configuration for VoLTE over IMS T-coil Testing

1. Codec investigation

An investigation was performed to determine the audio codec to be used for testing.

For LTE-FDD, the NB AMR 4.75 kbps setting was used for the audio codec on the CMW500 for VoLTE over IMS T-coil testing.

AMR Codec Investigation - VoLTE over IMS									
Codec Setting	**WB AMR 23.85kbps**	**WB AMR 15.85kbps**	**WB AMR 6.60 kbps**	**NB AMR 12.2 kbps**	**NB AMR 7.4kbps**	**NB AMR 4.75 kbps**	**Orientation**	**Band /BW**	**Channel**
ABM1 (dBA/m)	-2.39	-1.9	-1.8	-2.6	-1.8	-1.95	z (Axial):	Band2/ 20MHz	18900
ABM2 (dBA/m)	-53.18	-52.72	-52.47	-53.32	-52.47	-52.43			
Frequency Response	pass	pass	pass	pass	pass	pass			
Signal Quality (dB)	50.79	50.82	50.67	50.72	50.67	**50.48**			

EVS Codec Investigation - VoLTE over IMS						
Codec Setting	**24.4kbps**	**9.60 kbps**	**5.9 kbps**	**Orientation**	**Band /BW**	**Channel**
ABM1 (dBA/m)	-1.51	-2.1	-1.27	z (Axial):	Band2/ 20MHz	18900
ABM2 (dBA/m)	**-52.58**	**-53.06**	**-52.1**			
Frequency Response	pass	pass	pass			
Signal Quality (dB)	51.07	50.96	50.83			

2. Air Interface Investigation

The worst case band for each probe orientation is additionally tested on all bandwidth combination.

LTE B2 at 20MHz is the worst case for the Axial and Radial probe orientation for FDD.

9 Summary Test Results

Result For GSM

Air Interface Investigation								
Mode	Channel /Frequency (MHz)	Probe Orientation	ABM1 [dB (A/m)]	ABM2 [dB (A/m)]	ABM SNR (dB)	Freq. Resp. Diff(dB)	Frequency Response	Category
GSM 850 Voice Coder Speechcodec Low	128/824.2	y (Radial):	-8.57	-49.52	40.95	/	/	T4
		z (Axial):	-1.40	-47.15	45.75	1.72	pass	T4
	190/836.6	y (Radial):	-8.54	-48.26	39.72	/	/	T4
		z (Axial):	-1.33	-46.45	45.12	1.68	pass	T4
	251/848.8	y (Radial):	-8.59	-49.78	41.19	/	/	T4
		z (Axial):	-1.37	-48.18	46.81	1.60	pass	T4

Band	Channel /Frequency (MHz)	Probe Orientation	ABM1 [dB (A/m)]	ABM2 [dB (A/m)]	ABM SNR (dB)	Freq. Resp. Diff(dB)	Frequency Response	T-Rating	Plot No.
GSM 850 Voice Coder Speechcodec Low	190/836.6	y (Radial):	-8.54	-48.26	39.72	/	/	T4	1
		z (Axial):	-1.33	-46.45	45.12	1.68	pass	T4	2
PCS 1900 Voice Coder Speechcodec Low	810/1909.8	y (Radial):	-7.50	-51.01	43.51	/	/	T4	3
		z (Axial):	-0.19	-50.49	50.30	1.81	pass	T4	4

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.

Result For WCDMA

Mode	Channel /Frequency (MHz)	Probe Orientation	ABM1 [dB (A/m)]	ABM2 [dB (A/m)]	ABM SNR (dB)	Freq. Resp. Diff(dB)	Frequency Response	Category
WCDMA B2 Voice Coder Speechcodec Low AMR 12.2kbps	9262/1852.4	y (Radial):	-8.19	-51.77	43.58	/	/	T4
		z (Axial):	-0.92	-52.97	52.05	0.63	Pass	T4
	9400/1880	y (Radial):	-7.77	-51.11	43.34	/	/	T4
		z (Axial):	-1.30	-53.21	**51.91**	0.64	Pass	T4
	9538/1907.6	y (Radial):	-8.10	-52.10	44.00	/	/	T4
		z (Axial):	-1.16	-53.89	52.73	0.69	Pass	T4

Band	Channel /Frequency (MHz)	Probe Orientation	ABM1 [dB (A/m)]	ABM2 [dB (A/m)]	ABM SNR (dB)	Freq. Resp. Diff(dB)	Frequency Response	T-Rating	Plot No.
WCDMA B2 Voice Coder Speechcodec Low AMR 12.2kbps	9400/1880	y (Radial):	-7.77	-51.11	43.34	/	/	T4	5
		z (Axial):	-1.30	-53.21	51.91	0.64	Pass	T4	6
WCDMA B4 Voice Coder Speechcodec Low AMR 12.2kbps	1413/1732.6	y (Radial):	-7.71	-51.73	44.02	/	/	T4	7
		z (Axial):	-0.88	-52.85	51.97	0.61	Pass	T4	8
WCDMA B5 Voice Coder Speechcodec Low AMR 12.2kbps	4183/836.6	y (Radial):	-7.93	-51.76	43.83	/	/	T4	9
		z (Axial):	-1.29	-52.87	51.58	0.90	Pass	T4	10

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.

Result For LTE

Air Interface Investigation									
Mode	Channel	Bandwidth (MHz)	Orientation	ABM1 [dB (A/m)]	ABM2 [dB (A/m)]	Ambient Noise [dB (A/m)]	Frequency Response Variation (dB)	Signal Quality (dB)	T-Rating
LTE FDD B2 Voice NB AMR Codec: 4.75kbit/s	18900	20	z (Axial):	-1.95	-52.43	-58.31	0.76	**50.48**	T4
		15		-1.9	-52.51	-58.31	0.81	50.61	T4
		10		-2.05	-52.96	-58.31	0.73	50.91	T4
		5		-2.11	-52.94	-58.31	0.89	50.83	T4
		3		-1.96	-52.73	-58.31	0.95	50.77	T4
		1.4		-1.9	-52.79	-58.31	1.12	50.89	T4
		20	y (Radial):	-9.38	-51.99	-58.87	/	42.61	T4
		15		-8.93	-52.15	-58.87	/	43.22	T4
		10		-9.36	-52.54	-58.87	/	43.18	T4
		5		-9.13	-52.5	-58.87	/	43.37	T4
		3		-9.03	-52.32	-58.87	/	43.29	T4
		1.4		-9.38	-52.62	-58.87	/	43.24	T4

Mode	Channel	Bandwidth (MHz)	Modulation	RB Size	RB Offset	ABM1 [dB (A/m)]	ABM2 [dB (A/m)]	Signal Quality (dB)
LTE FDD B2 Voice NB AMR Codec: 4.75kbit/s	18900	20	QPSK	1	0	-1.95	-52.43	**50.48**
				1	50	-1.8	-53.17	51.37
				1	99	-0.9	-52.52	51.62
				50	0	0.58	-52.01	52.59
				50	25	-0.73	-52.65	51.92
				50	50	-1.25	-53.31	52.06
				100	0	0.86	-52.54	53.40
			16QAM	1	0	0.89	-51.82	52.71
				1	50	1.03	-51.93	52.96
				1	99	0.95	-52.22	53.17
				50	0	1.1	-52.47	53.57
				50	25	1.2	-52.28	53.48
				50	50	0.97	-52.29	53.26
				100	0	1.28	-52.34	53.62

Mode	Channel /Frequency (MHz)	Probe Orientation	ABM1 [dB (A/m)]	ABM2 [dB (A/m)]	ABM SNR (dB)	Freq. Resp. Diff(dB)	Frequency Response	T-Rating
LTE FDD B2 Voice NB AMR Codec: 4.75kbit/s	18700/1860 (QPSK_20M_1RB_0offset)	y (Radial):	-6.31	-51.31	45.00	/	/	T4
		z (Axial):	0.63	-52.23	52.86	0.82	pass	T4
	18900/1880 (QPSK_20M_1RB_0offset)	y (Radial):	-8.07	-48.14	40.07	/	/	T4
		z (Axial):	-1.95	-52.43	**50.48**	0.76	pass	T4
	19100/1900 (QPSK_20M_1RB_0offset)	y (Radial):	-8.93	-49.39	40.46	/	/	T4
		z (Axial):	0.87	-52.51	53.38	1.14	pass	T4
LTE FDD B2 Voice NB AMR Codec: 4.75kbit/s	18900/1880 (16QAM_20M_1RB_0offset)	y (Radial):	-9.26	-50.83	41.57	/	/	T4
		z (Axial):	-2.35	-54.12	51.77	0.83	pass	T4

Band	Channel /Frequency (MHz)	Probe Orientation	ABM1 [dB (A/m)]	ABM2 [dB (A/m)]	ABM SNR (dB)	Freq. Resp. Diff(dB)	Frequency Response	T-Rating	Plot No.
LTE FDD B2 Voice NB AMR Codec: 4.75kbit/s	18900/1880 (QPSK_20M_1RB_0offset)	y (Radial):	-8.07	-48.14	40.07	/	/	T4	11
		z (Axial):	-1.95	-52.43	50.48	0.76	pass	T4	12
LTE FDD B4 Voice NB AMR Codec: 4.75kbit/s	20175/1732.5 (QPSK_20M_1RB_0offset)	y (Radial):	-9.22	-51.02	41.80	/	/	T4	13
		z (Axial):	-2.14	-51.73	49.59	0.70	pass	T4	14
LTE FDD B5 Voice NB AMR Codec: 4.75kbit/s	20525/836.5 (QPSK_10M_1RB_0offset)	y (Radial):	-8.65	-50.62	41.97	/	/	T4	15
		z (Axial):	-1.22	-51.95	50.73	1.01	pass	T4	16
LTE FDD B12 Voice NB AMR Codec: 4.75kbit/s	23095/707.5 (QPSK_10M_1RB_0offset)	y (Radial):	-8.60	-50.71	42.11	/	/	T4	17
		z (Axial):	-1.63	-51.86	50.23	0.67	pass	T4	18
LTE FDD B66 Voice NB AMR Codec: 4.75kbit/s	132322/1745 (QPSK_20M_1RB_0offset)	y (Radial):	-7.49	-50.49	43.00	/	/	T4	19
		z (Axial):	-2.30	-51.54	49.24	0.96	pass	T4	20

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.

10 Measurement Uncertainty

Measurement uncertainty evaluation template for DUT HAC T-Coil test

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	

11 Main Test Instruments

Name	Manufacturer	Type	Serial Number	Last Cal.	Cal. Due Date
Audio Magnetic 1D Field Probe	SPEAG	AM1DV3	3082	2021-02-23	2022-02-22
				2022-02-23	2023-02-22
DAE	SPEAG	DAE4	1692	2021-10-04	2022-10-03
Universal Radio Communication Tester	R&S	CMW 500	146734	2021-05-15	2022-05-14
				2022-05-14	2023-05-13
Audio Magnetic Calibration Coil	SPEAG	AMCC	1101	/	/
Hygrothermograph	Anymetr	NT-311	20150731	2021-05-18	2022-05-17
				2022-05-18	2023-05-17
HAC Phantom	SPEAG	SD HAC P01 BB	1117	/	/
Software for Test	Speag	DASY5	/	/	/

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

ANNEX A: Test Layout

Picture 1: HAC T-Coil System Layout

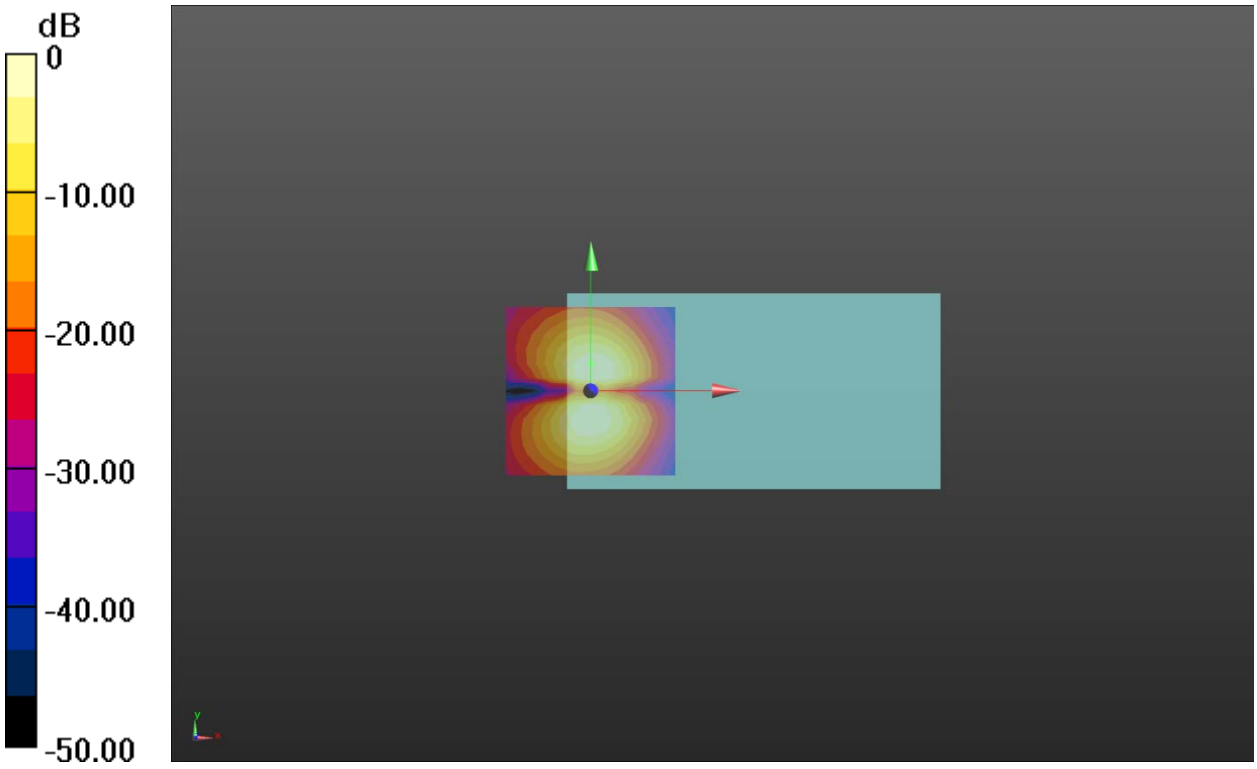
ANNEX B: Graph Results

Plot 1 T-Coil GSM 850 Y transversal

Date: 2021/12/30
Communication System: UID 10021 - DAC, GSM-FDD (TDMA, GMSK); Frequency: 836.6 MHz;Duty Cycle: 1:8.69961
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3
Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 2021/2/23
Electronics: DAE4 SN1692; Calibrated: 2021/10/4
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

GSM850 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: 0.17 dB
Device Reference Point: 0, 0, -6.3 mm

Cursor:
ABM1/ABM2 = 39.72 dB
ABM1 comp = -8.54 dBA/m
BWC Factor = 0.17 dB
Location: 0, 8.3, 3.7 mm



0 dB = 96.87 = 39.72 dB

Plot 2 T-Coil GSM 850 Z Axial

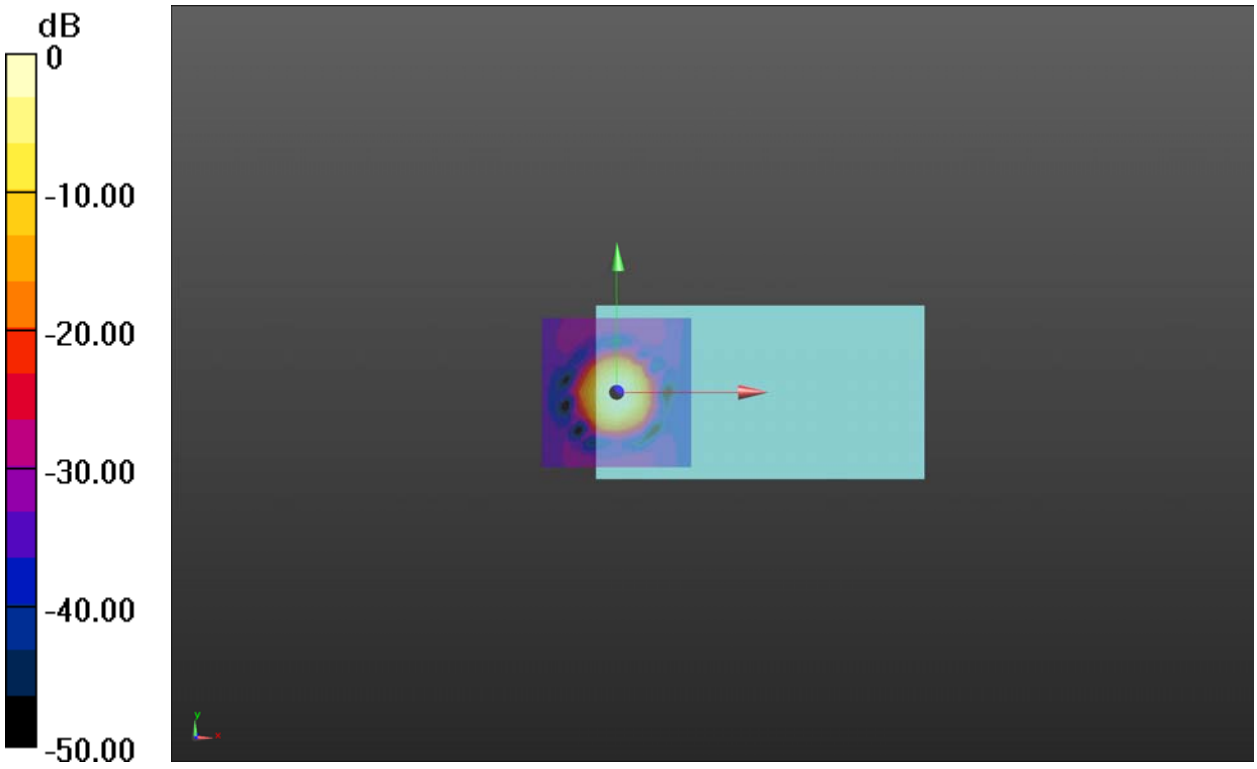
Date: 2021/12/30
Communication System: UID 10021 - DAC, GSM-FDD (TDMA, GMSK); Frequency: 836.6 MHz;Duty Cycle: 1:8.69961
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3
Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 2021/2/23
Electronics: DAE4 SN1692; Calibrated: 2021/10/4
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

GSM850 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: 0.17 dB
Device Reference Point: 0, 0, -6.3 mm

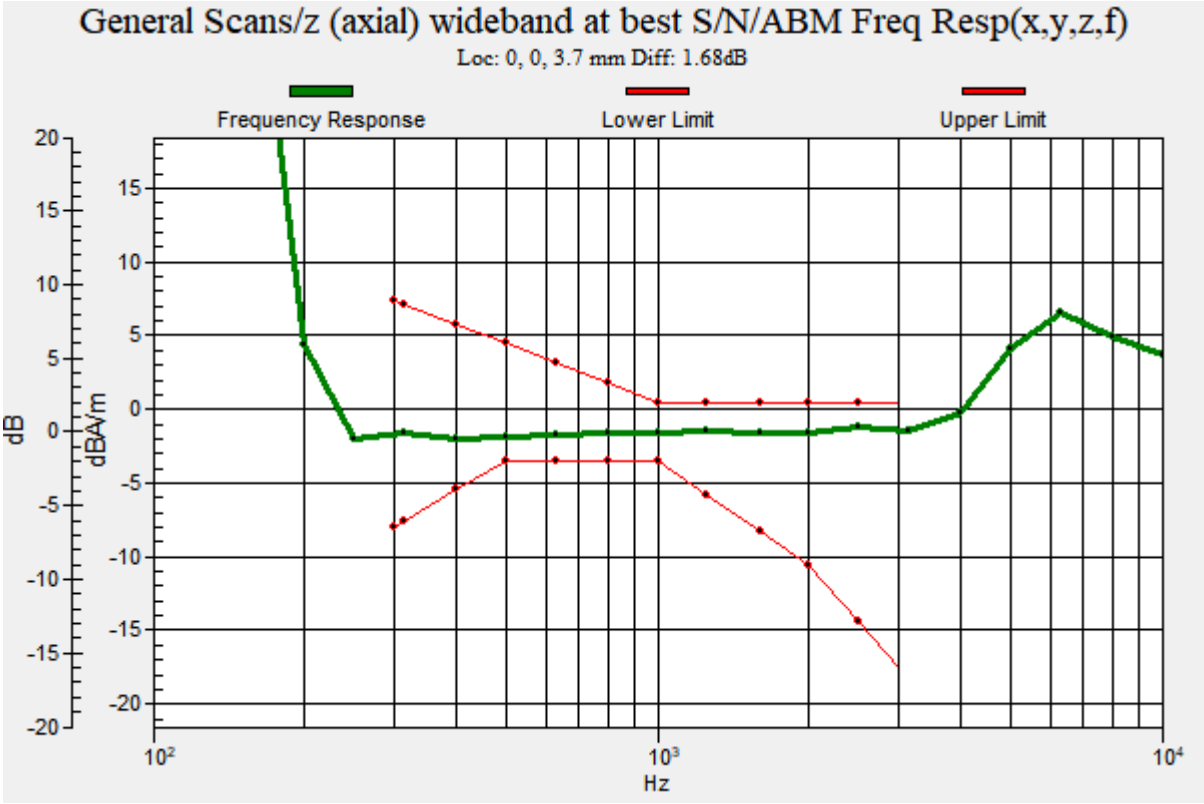
Cursor:
ABM1/ABM2 = 45.12 dB
ABM1 comp = -1.33 dBA/m
BWC Factor = 0.17 dB
Location: 0, 0, 3.7 mm

GSM850 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 = 1.68 dB
BWC Factor = 10.81 dB
Location: 0, 0, 3.7 mm



0 dB = 180.4 = 45.12 dB



Plot 3 T-Coil GSM 1900 Y transversal

Date: 2022/1/11

Communication System: UID 10021 - DAC, GSM-FDD (TDMA, GMSK); Frequency: 1880 MHz;Duty Cycle: 1:8.69961

Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 2021/2/23

Electronics: DAE4 SN1692; Calibrated: 2021/10/4

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

Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

PCS1900 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: 0.17 dB

Device Reference Point: 0, 0, -6.3 mm

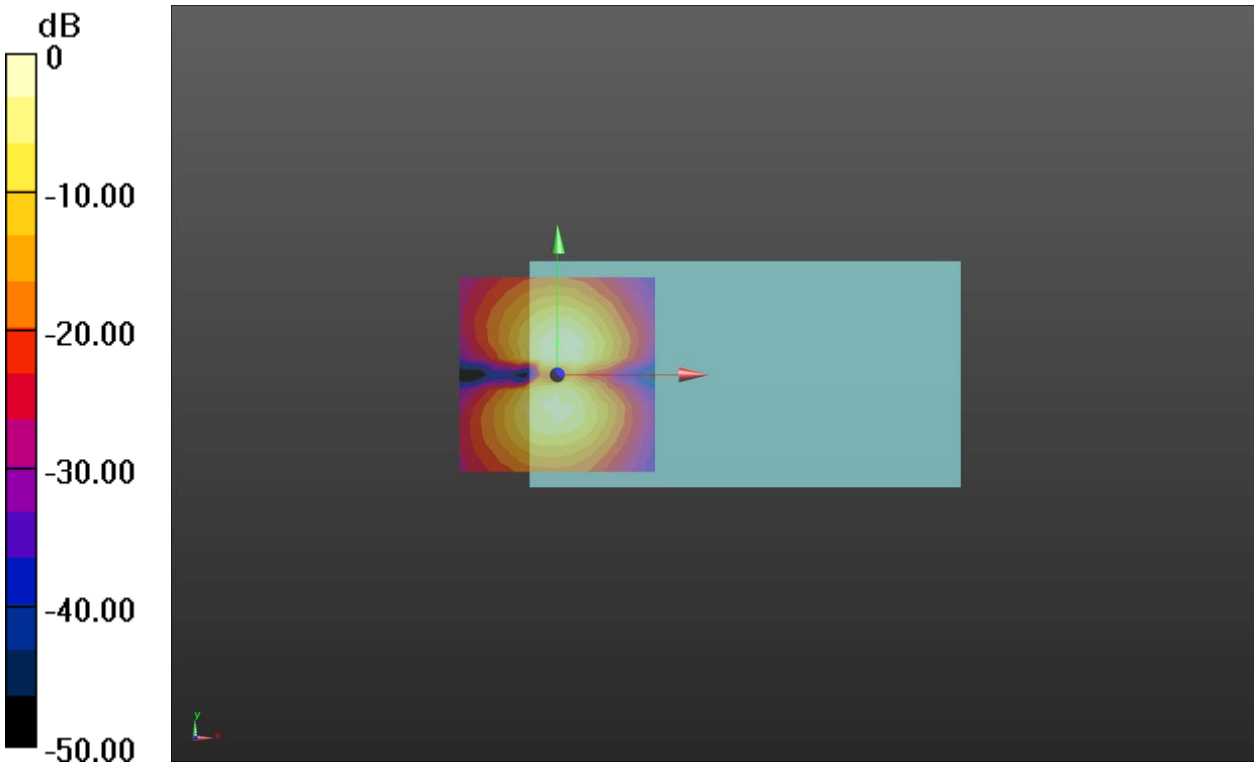
Cursor:

ABM1/ABM2 = 43.51 dB

ABM1 comp = -7.50 dBA/m

BWC Factor = 0.17 dB

Location: 0, 8.3, 3.7 mm



0 dB = 149.8 = 43.51 dB

Plot 4 T-Coil GSM 1900 Z Axial

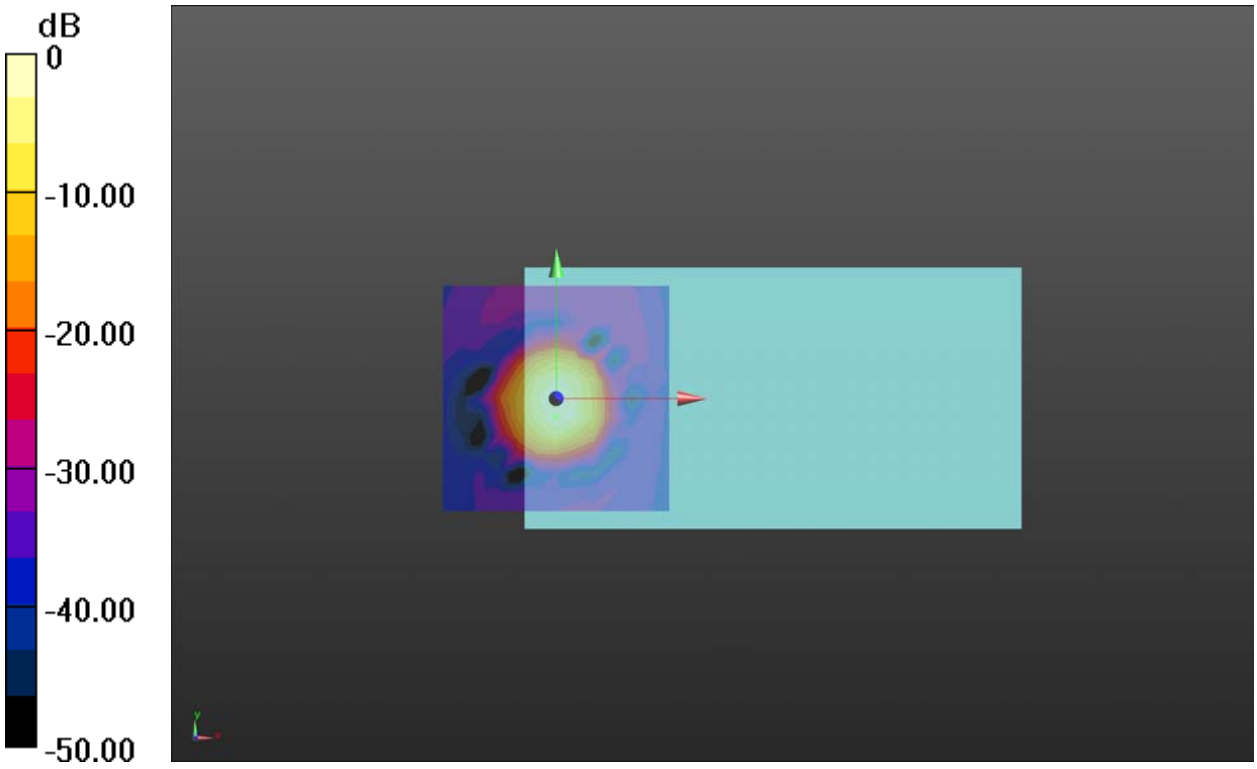
Date: 2022/1/11
Communication System: UID 10021 - DAC, GSM-FDD (TDMA, GMSK); Frequency: 1880 MHz;Duty Cycle: 1:8.69961
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3
Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 2021/2/23
Electronics: DAE4 SN1692; Calibrated: 2021/10/4
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

PCS1900 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: 0.17 dB
Device Reference Point: 0, 0, -6.3 mm

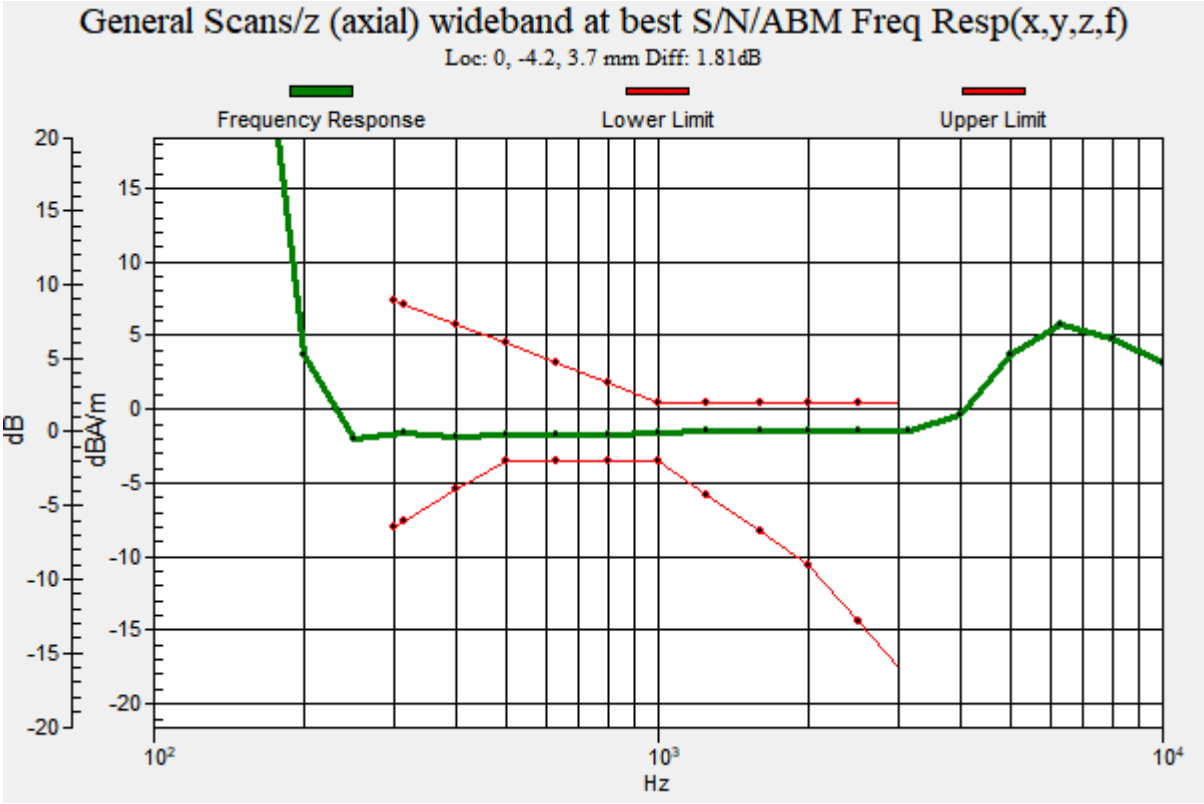
Cursor:
ABM1/ABM2 = 50.30 dB
ABM1 comp = -0.19 dBA/m
BWC Factor = 0.17 dB
Location: 0, -4.2, 3.7 mm

PCS1900 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 = 1.81 dB
BWC Factor = 10.81 dB
Location: 0, -4.2, 3.7 mm



0 dB = 327.4 = 50.30 dB



Plot 5 T-Coil WCDMA Band II Y transversal

Date: 2022/1/12

Communication System: UID 10011 - CAB, UMTS-FDD (WCDMA); Frequency: 1880 MHz;Duty Cycle: 1:1.95434

Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 2021/2/23

Electronics: DAE4 SN1692; Calibrated: 2021/10/4

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

Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

WCDMA 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: 0.17 dB

Device Reference Point: 0, 0, -6.3 mm

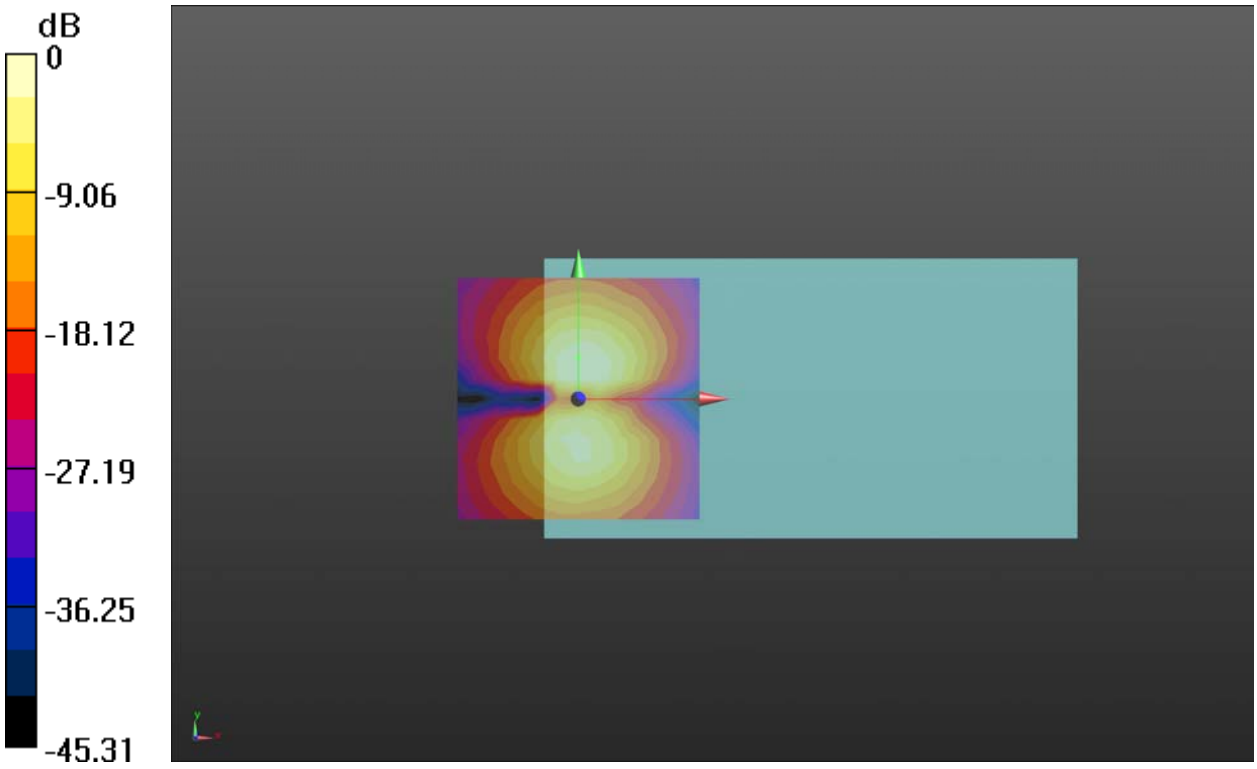
Cursor:

ABM1/ABM2 = 43.34 dB

ABM1 comp = -7.77 dBA/m

BWC Factor = 0.17 dB

Location: 0, 8.3, 3.7 mm



0 dB = 146.8 = 43.33 dB

Plot 6 T-Coil WCDMA Band II Z Axial

Date: 2022/7/11

Communication System: UID 10011 - CAB, UMTS-FDD (WCDMA); Frequency: 1880 MHz;Duty Cycle: 1:1.95434

Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 2022/2/23

Electronics: DAE4 SN1692; Calibrated: 2021/10/4

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

Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

WCDMA 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: 0.17 dB

Device Reference Point: 0, 0, -6.3 mm

Cursor:

ABM1/ABM2 = 51.91 dB

ABM1 comp = -1.30 dBA/m

BWC Factor = 0.17 dB

Location: 0, 0, 3.7 mm

WCDMA 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: 10.81 dB

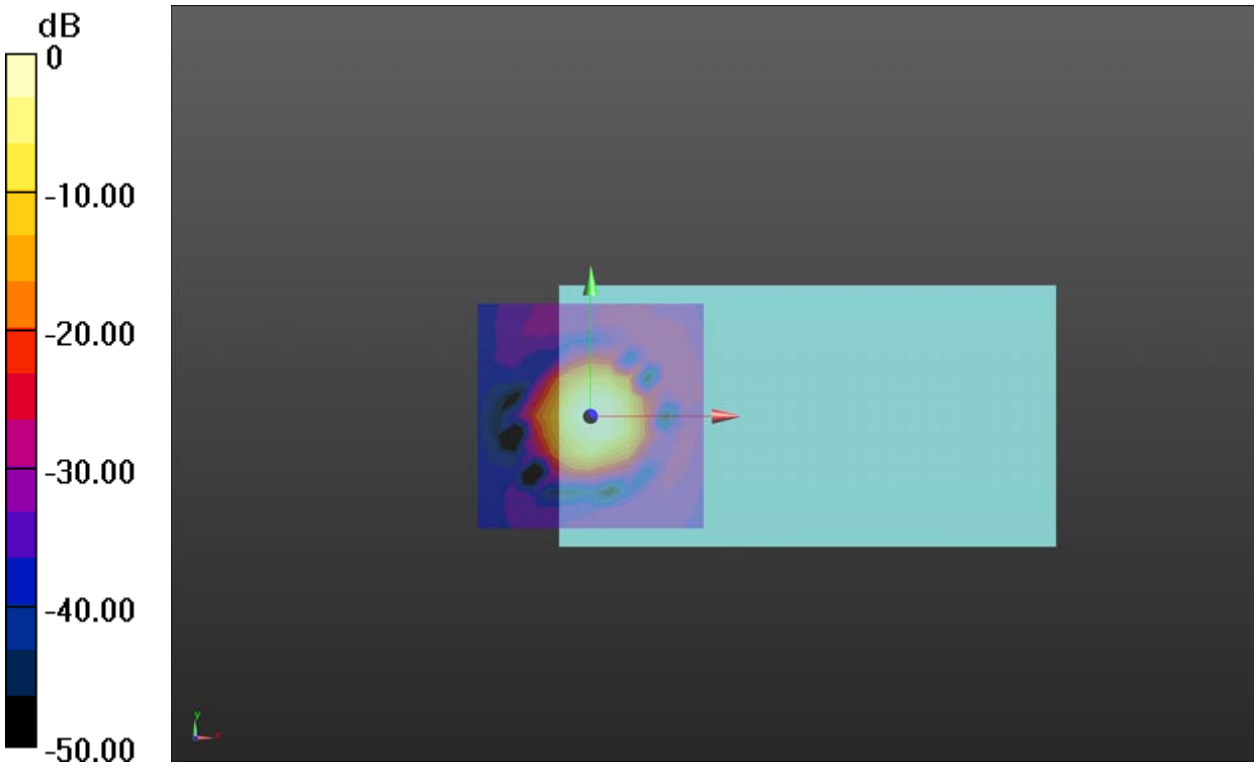
Device Reference Point: 0, 0, -6.3 mm

Cursor:

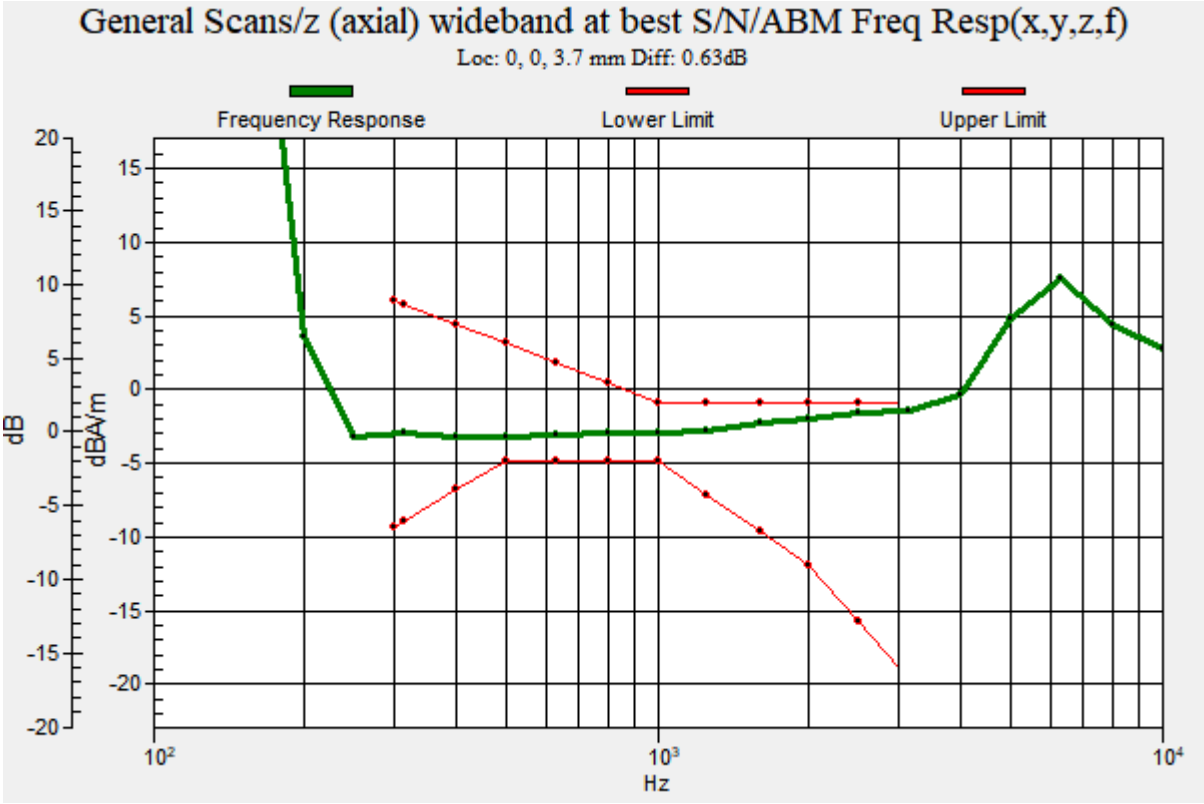
Diff = 0.64 dB

BWC Factor = 10.81 dB

Location: 0, 0, 3.7 mm



0 dB = 394.1 = 51.91 dB



Plot 7 T-Coil WCDMA Band IV Y transversal

Date: 2022/1/12

Communication System: UID 10011 - CAB, UMTS-FDD (WCDMA); Frequency: 1732.6 MHz;Duty Cycle: 1:1.95434

Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 2021/2/23

Electronics: DAE4 SN1692; Calibrated: 2021/10/4

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

Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

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: 0.17 dB

Device Reference Point: 0, 0, -6.3 mm

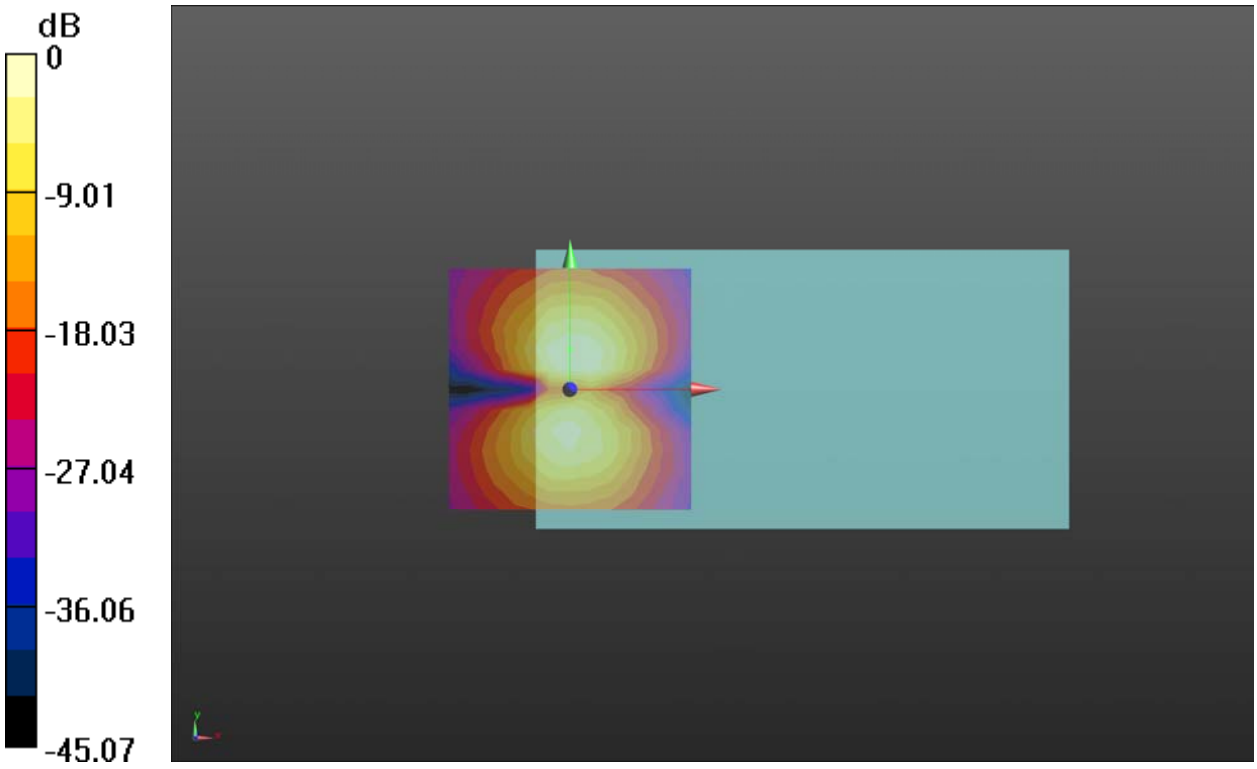
Cursor:

ABM1/ABM2 = 44.02 dB

ABM1 comp = -7.71 dBA/m

BWC Factor = 0.17 dB

Location: 0, 8.3, 3.7 mm



0 dB = 158.8 = 44.02 dB

Plot 8 T-Coil WCDMA Band IV Z Axial

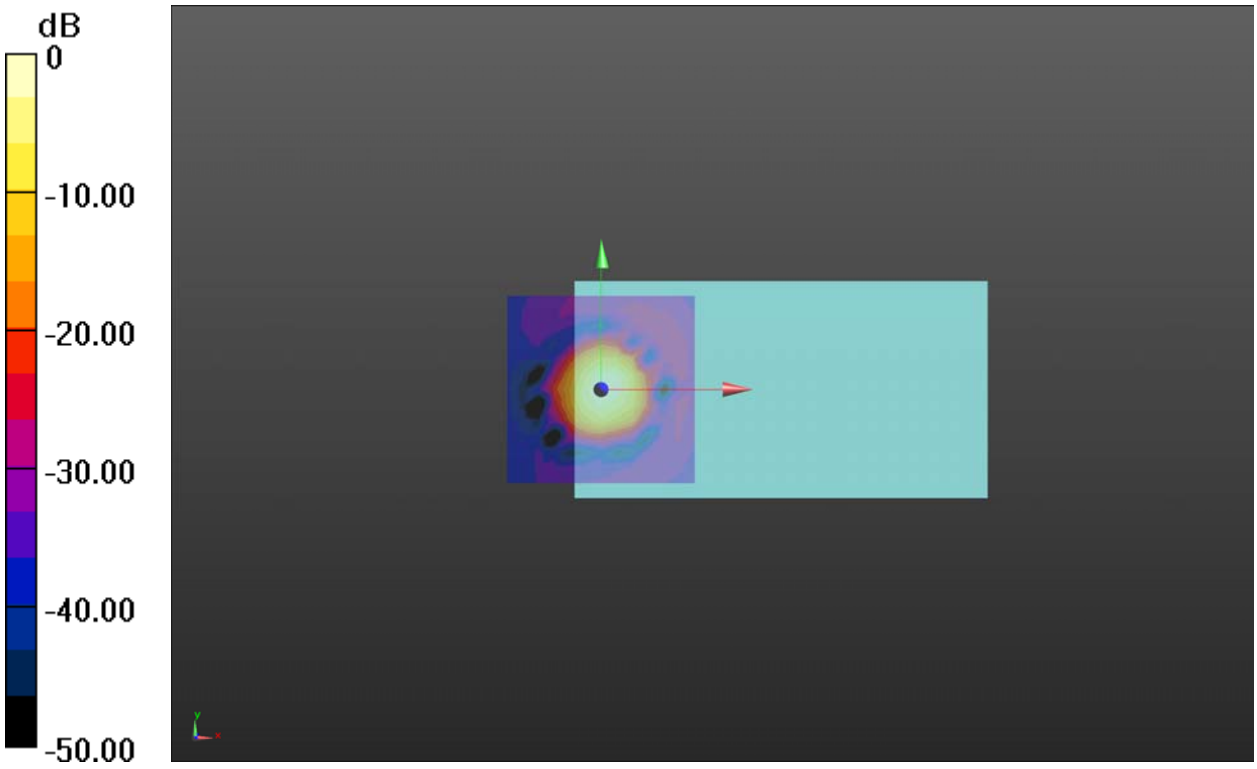
Date: 2022/7/11
Communication System: UID 10011 - CAB, UMTS-FDD (WCDMA); Frequency: 1732.6 MHz;Duty Cycle: 1:1.95434
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3
Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 2022/2/23
Electronics: DAE4 SN1692; Calibrated: 2021/10/4
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

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: 0.17 dB
Device Reference Point: 0, 0, -6.3 mm

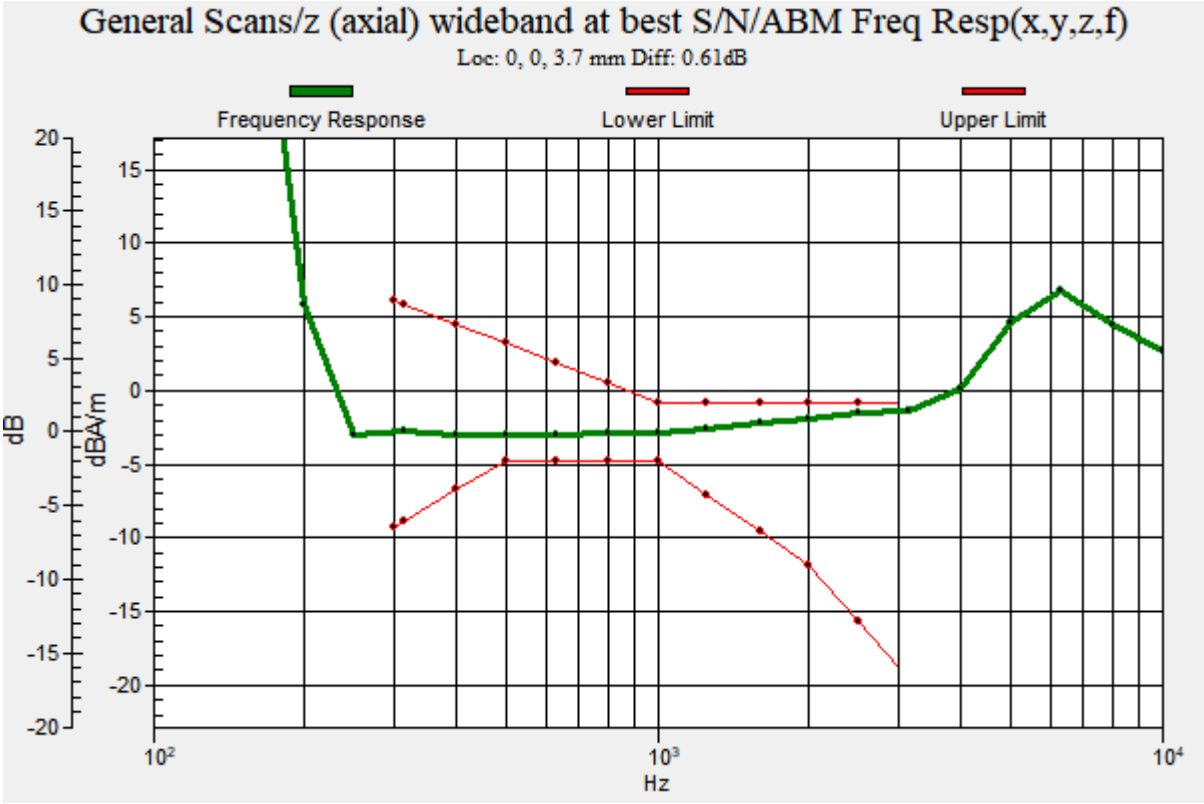
Cursor:
ABM1/ABM2 = 51.97 dB
ABM1 comp = -0.88 dBA/m
BWC Factor = 0.17 dB
Location: 0, 0, 3.7 mm

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 = 0.61 dB
BWC Factor = 10.81 dB
Location: 0, 0, 3.7 mm



0 dB = 396.7 = 51.97 dB



Plot 9 T-Coil WCDMA Band V Y transversal

Date: 2022/1/12

Communication System: UID 10011 - CAB, UMTS-FDD (WCDMA); Frequency: 836.6 MHz;Duty Cycle: 1:1.95434

Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 2021/2/23

Electronics: DAE4 SN1692; Calibrated: 2021/10/4

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

Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

WCDMA 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: 0.17 dB

Device Reference Point: 0, 0, -6.3 mm

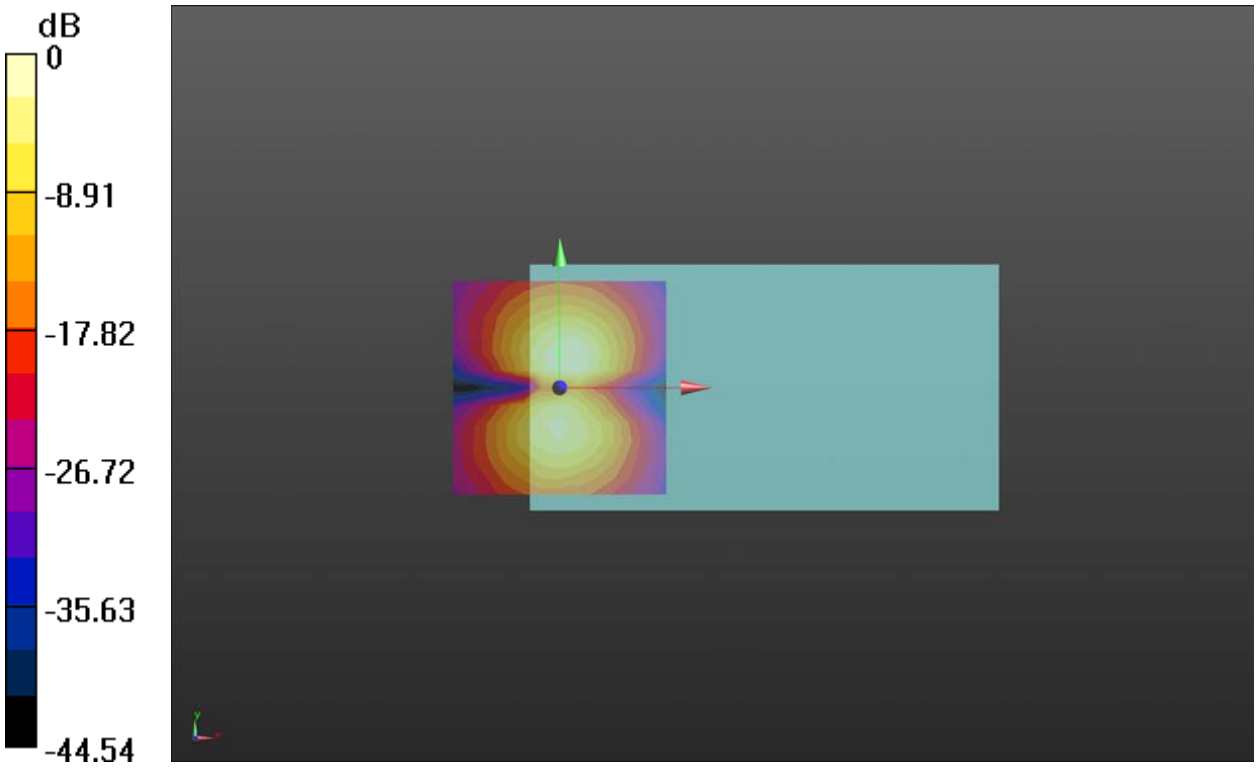
Cursor:

ABM1/ABM2 = 43.83 dB

ABM1 comp = -7.93 dBA/m

BWC Factor = 0.17 dB

Location: 0, 8.3, 3.7 mm



0 dB = 155.5 = 43.83 dB

Plot 10 T-Coil WCDMA Band V Z Axial

Date: 2022/7/11

Communication System: UID 10011 - CAB, UMTS-FDD (WCDMA); Frequency: 836.6 MHz;Duty Cycle: 1:1.95434

Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 2022/2/23

Electronics: DAE4 SN1692; Calibrated: 2021/10/4

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

Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

WCDMA 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: 0.17 dB

Device Reference Point: 0, 0, -6.3 mm

Cursor:

ABM1/ABM2 = 51.58 dB

ABM1 comp = -1.29 dBA/m

BWC Factor = 0.17 dB

Location: 0, 0, 3.7 mm

WCDMA 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: 10.81 dB

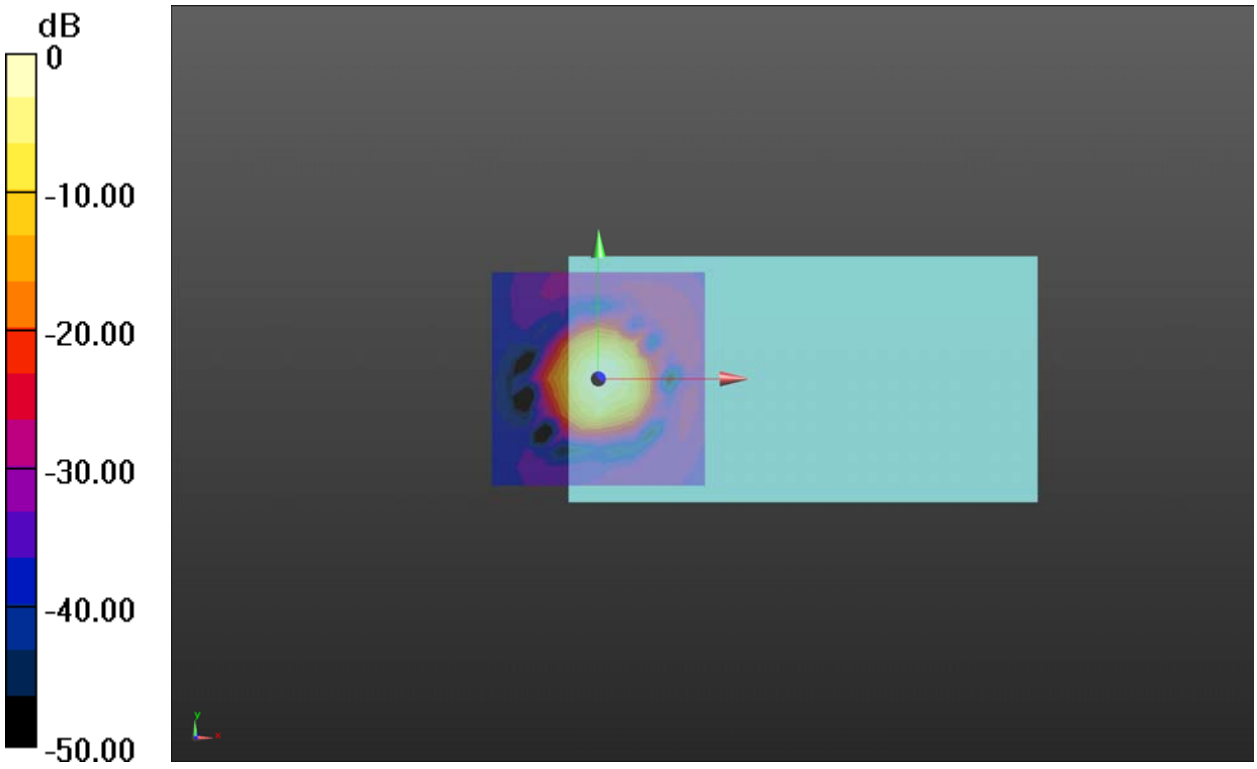
Device Reference Point: 0, 0, -6.3 mm

Cursor:

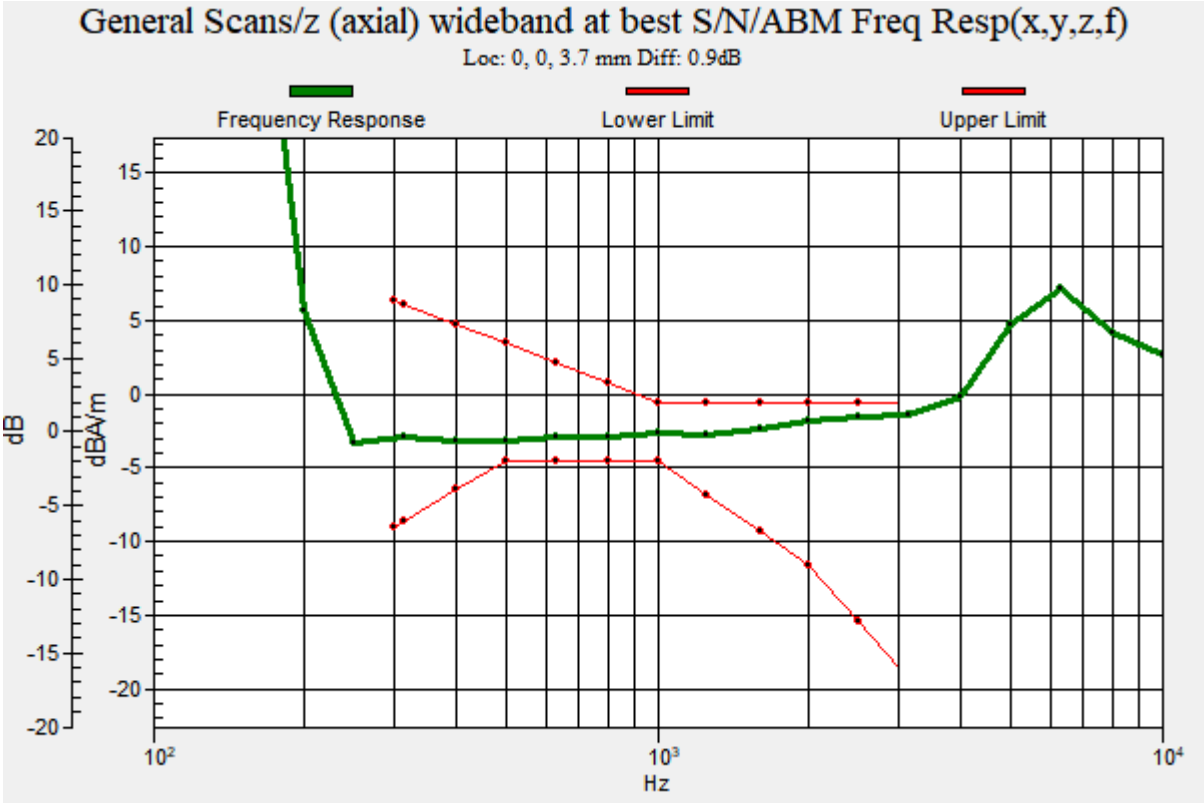
Diff = 0.90 dB

BWC Factor = 10.81 dB

Location: 0, 0, 3.7 mm



0 dB = 379.2 = 51.58 dB



Plot 11 T-Coil LTE Band 2 Y transversal

Date: 2022/1/25

Communication System: UID 10169 - CAE, LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 1880 MHz;Duty Cycle: 1:3.73852

Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 2021/2/23

Electronics: DAE4 SN1692; Calibrated: 2021/10/4

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

Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

LTE B2 1RB HAC_TCoil_WD_Emission-4.75kbps/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

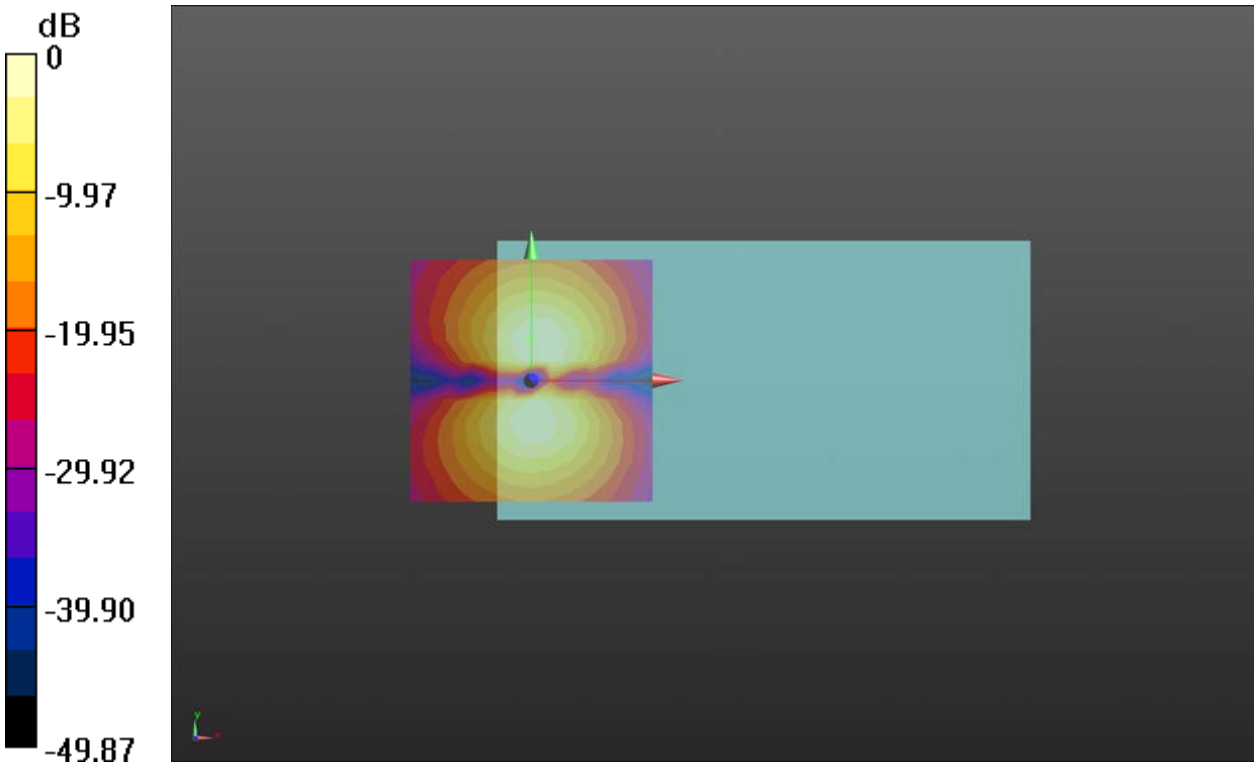
Cursor:

ABM1/ABM2 = 40.07 dB

ABM1 comp = -8.07 dBA/m

BWC Factor = 0.16 dB

Location: 0, 8.3, 3.7 mm



0 dB = 100.8 = 40.07 dB

Plot 12 T-Coil LTE Band 2 Z Axial

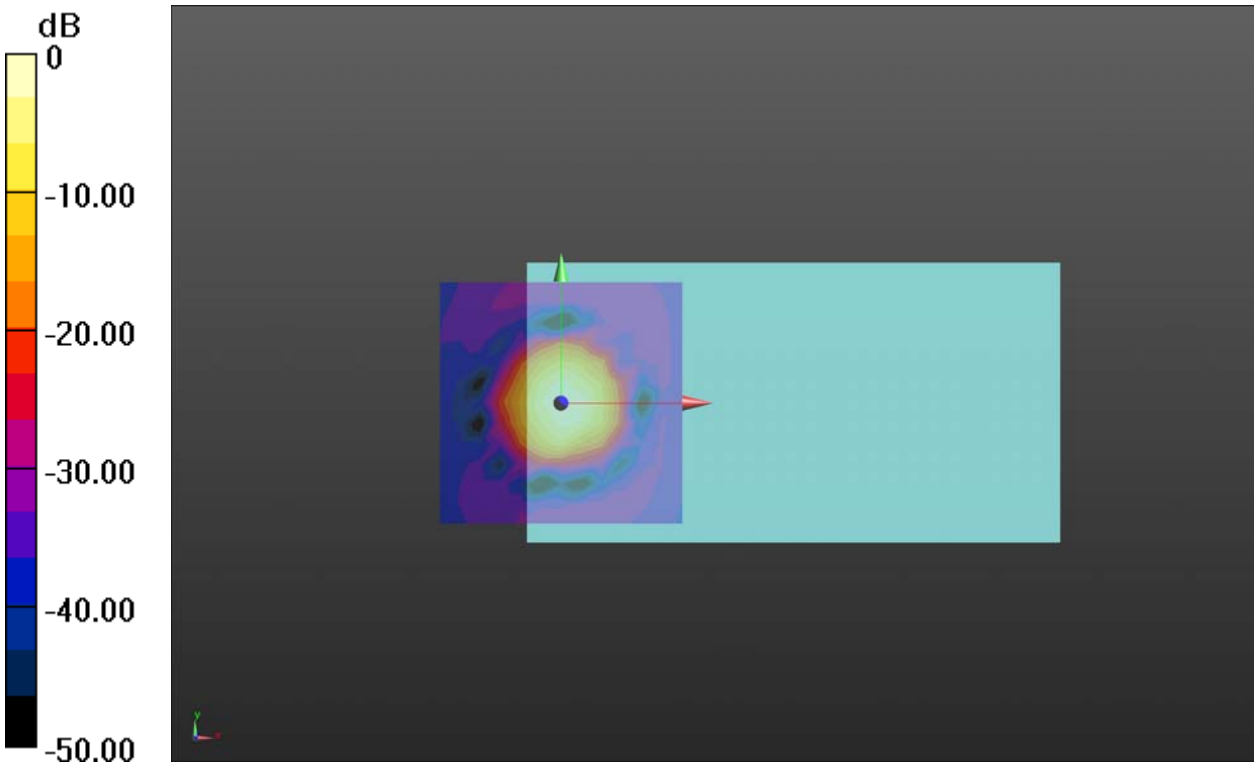
Date: 2022/1/25
Communication System: UID 10169 - CAE, LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 1880 MHz;Duty Cycle: 1:3.73852
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3
Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 2021/2/23
Electronics: DAE4 SN1692; Calibrated: 2021/10/4
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

LTE B2 1RB HAC_TCoil_WD_Emission-4.75kbps/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

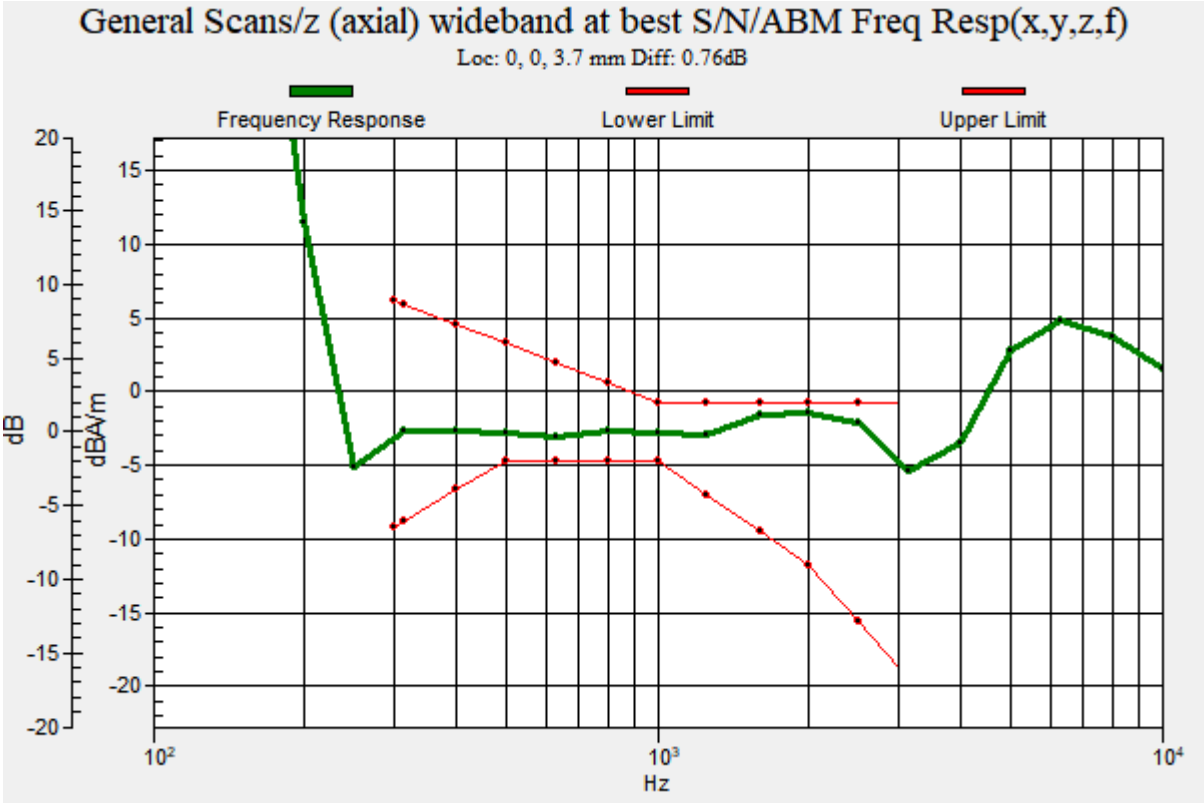
Cursor:
ABM1/ABM2 = 50.48 dB
ABM1 comp = -1.95 dBA/m
BWC Factor = 0.16 dB
Location: 0, 0, 3.7 mm

LTE B2 1RB HAC_TCoil_WD_Emission-4.75kbps/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 = 0.76 dB
BWC Factor = 10.81 dB
Location: 0, 0, 3.7 mm



0 dB = 334.2 = 50.48 dB



Plot 13 T-Coil LTE Band 4 Y transversal

Date: 2022/1/25

Communication System: UID 10169 - CAE, LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 1732.5 MHz;Duty Cycle: 1:3.73852

Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 2021/2/23

Electronics: DAE4 SN1692; Calibrated: 2021/10/4

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

Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

LTE B4 1RB HAC_TCoil_WD_Emission-4.75kbps/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

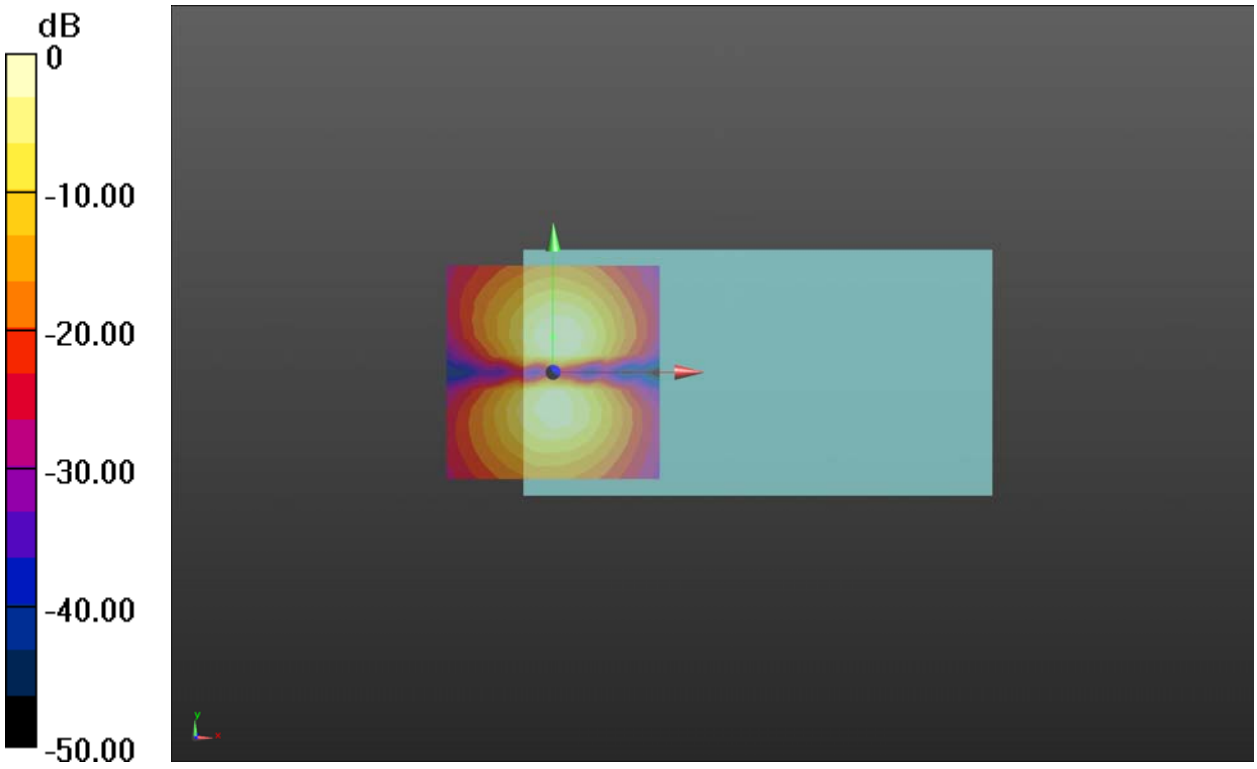
Cursor:

ABM1/ABM2 = 41.80 dB

ABM1 comp = -9.22 dBA/m

BWC Factor = 0.16 dB

Location: 0, 8.3, 3.7 mm



0 dB = 123.1 = 41.81 dB

Plot 14 T-Coil LTE Band 4 Z Axial

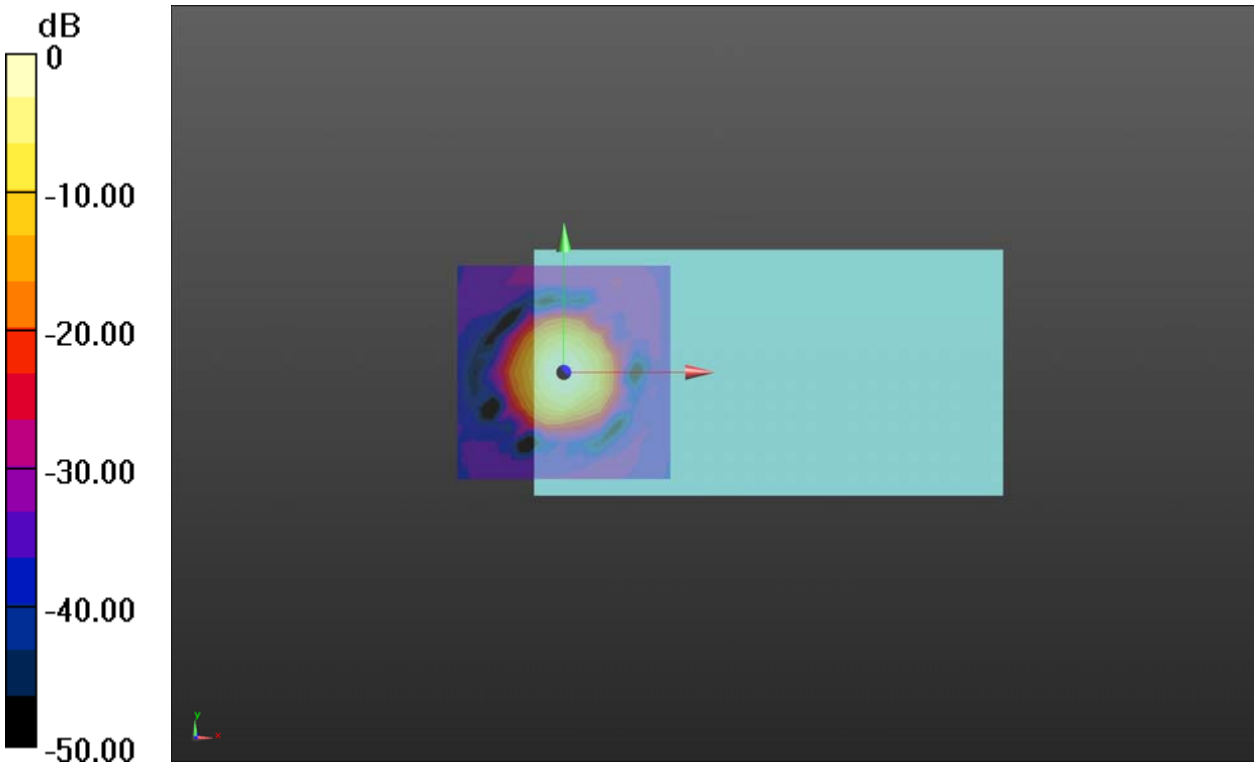
Date: 2022/1/25
Communication System: UID 10169 - CAE, LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 1732.5 MHz;Duty Cycle: 1:3.73852
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3
Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 2021/2/23
Electronics: DAE4 SN1692; Calibrated: 2021/10/4
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

LTE B4 1RB HAC_TCoil_WD_Emission-4.75kbps/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

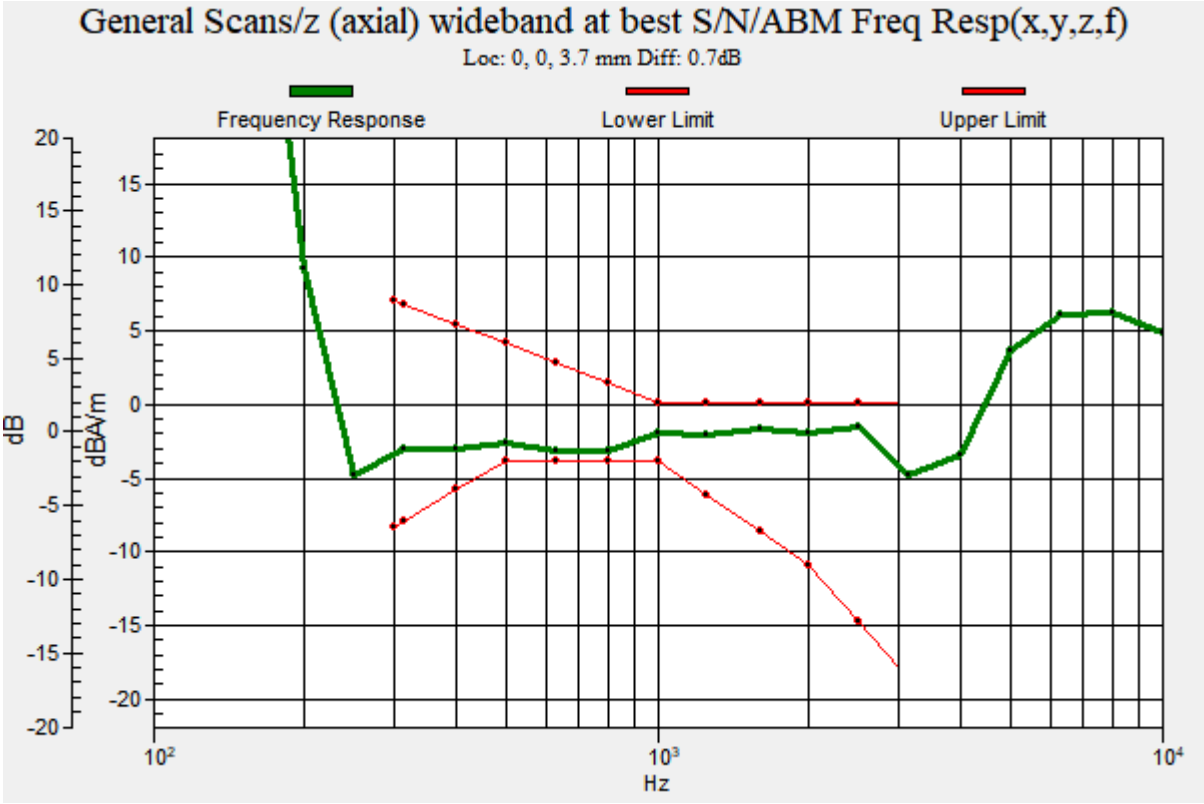
Cursor:
ABM1/ABM2 = 49.59 dB
ABM1 comp = -2.14 dBA/m
BWC Factor = 0.16 dB
Location: 0, 0, 3.7 mm

LTE B4 1RB HAC_TCoil_WD_Emission-4.75kbps/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 = 0.70 dB
BWC Factor = 10.81 dB
Location: 0, 0, 3.7 mm



0 dB = 301.5 = 49.59 dB



Plot 15 T-Coil LTE Band 5 Y transversal

Date: 2022/1/29

Communication System: UID 10175 - CAG, LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK); Frequency: 836.5 MHz;Duty Cycle: 1:3.73594

Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 2021/2/23

Electronics: DAE4 SN1692; Calibrated: 2021/10/4

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

Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

LTE B5 1RB HAC_TCoil_WD_Emission-4.75kbps/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

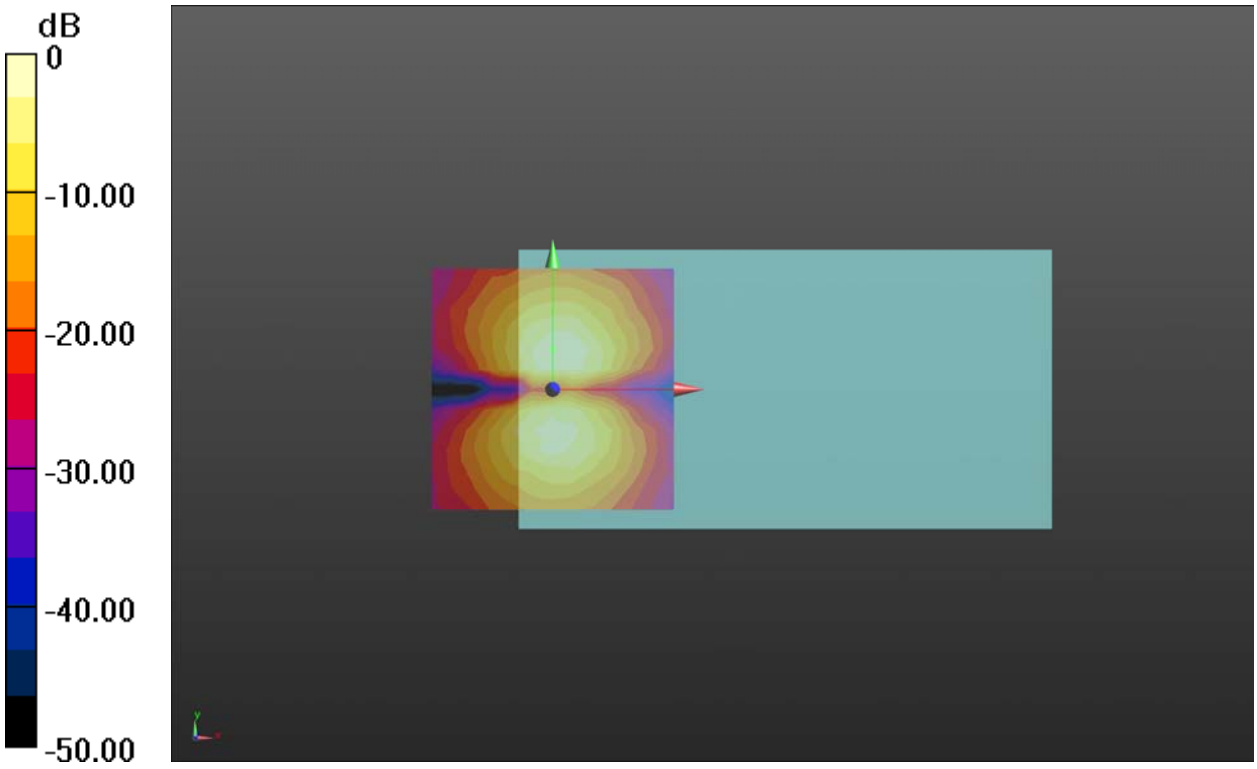
Cursor:

ABM1/ABM2 = 41.97 dB

ABM1 comp = -8.65 dBA/m

BWC Factor = 0.16 dB

Location: 0, 8.3, 3.7 mm



0 dB = 125.4 = 41.97 dB

Plot 16 T-Coil LTE Band 5 Z Axial

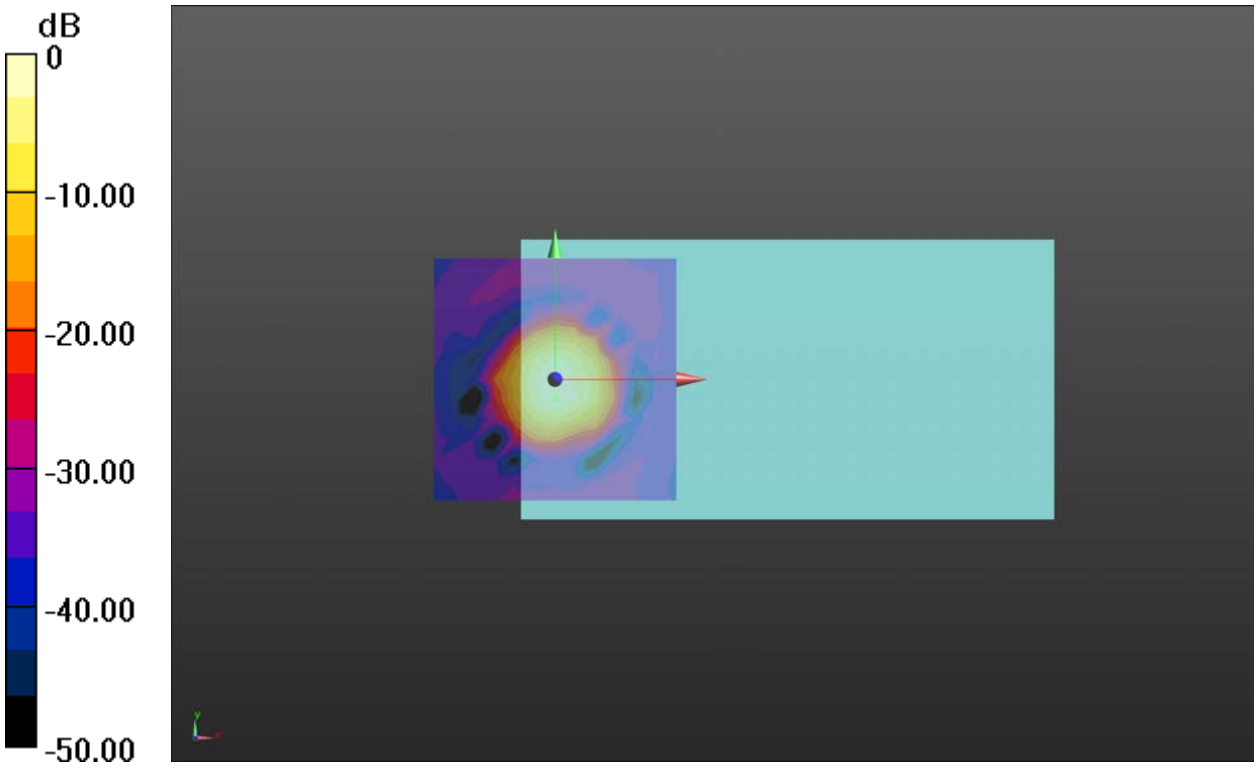
Date: 2022/1/29
Communication System: UID 10175 - CAG, LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK); Frequency: 836.5 MHz;Duty Cycle: 1:3.73594
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3
Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 2021/2/23
Electronics: DAE4 SN1692; Calibrated: 2021/10/4
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

LTE B5 1RB HAC_TCoil_WD_Emission-4.75kbps/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

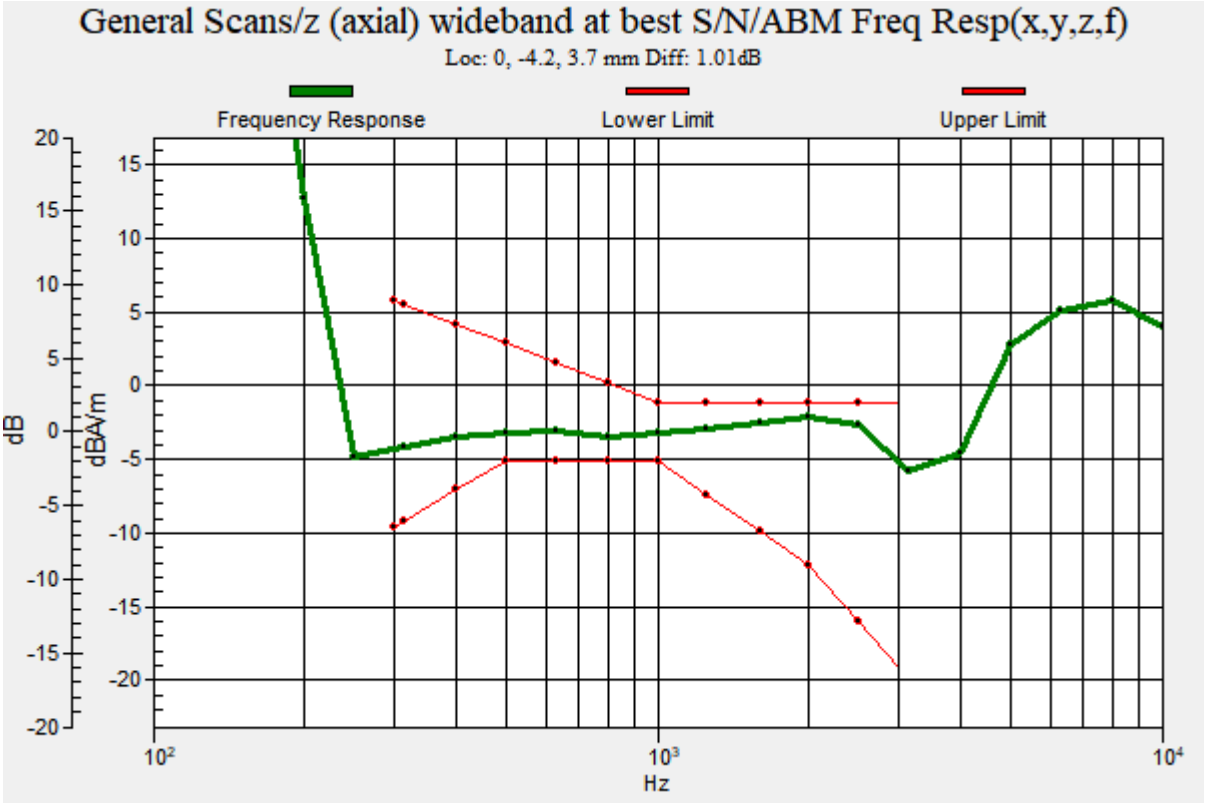
Cursor:
ABM1/ABM2 = 50.73 dB
ABM1 comp = -1.22 dBA/m
BWC Factor = 0.16 dB
Location: 0, -4.2, 3.7 mm

LTE B5 1RB HAC_TCoil_WD_Emission-4.75kbps/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 = 1.01 dB
BWC Factor = 10.81 dB
Location: 0, -4.2, 3.7 mm



0 dB = 344.0 = 50.73 dB



Plot 17 T-Coil LTE Band 12 Y transversal

Date: 2022/2/7

Communication System: UID 10175 - CAG, LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK); Frequency: 707.5 MHz;Duty Cycle: 1:3.73594

Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 2021/2/23

Electronics: DAE4 SN1692; Calibrated: 2021/10/4

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

Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

LTE B5 1RB HAC_TCoil_WD_Emission-4.75kbps/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

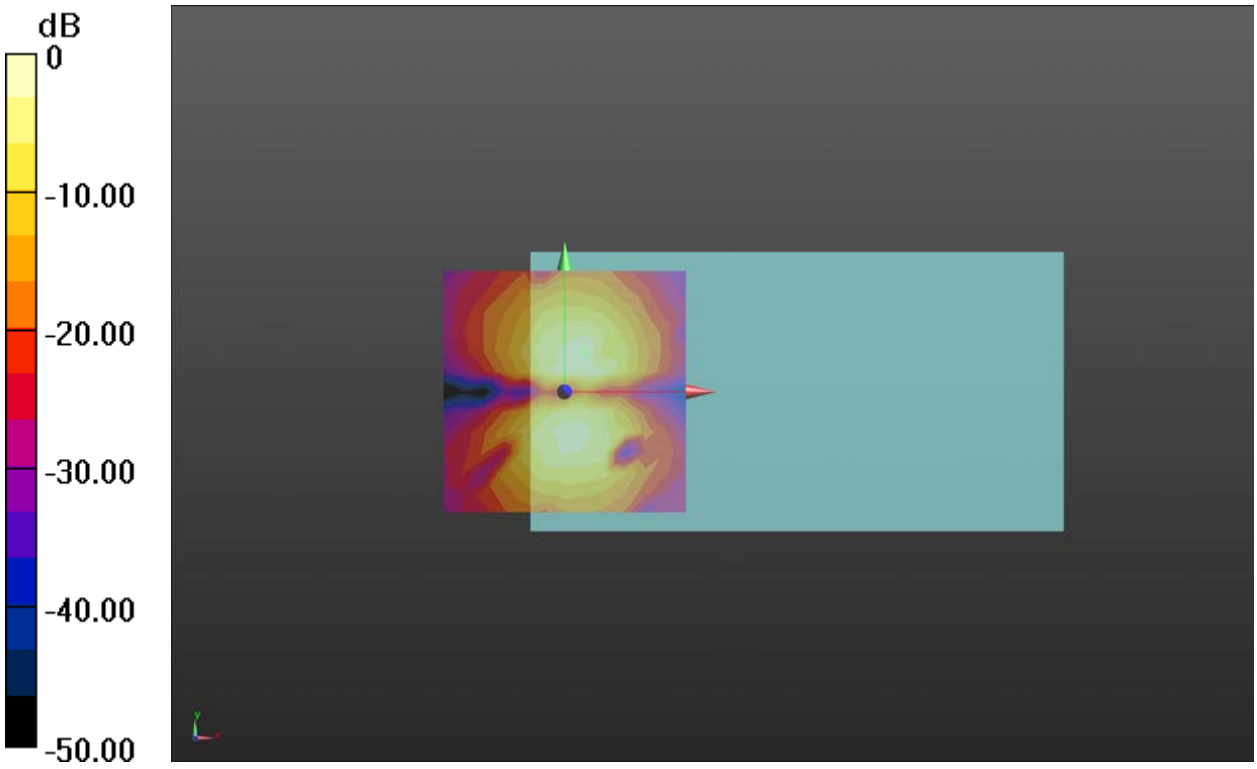
Cursor:

ABM1/ABM2 = 42.11 dB

ABM1 comp = -8.60 dBA/m

BWC Factor = 0.16 dB

Location: 4.2, 8.3, 3.7 mm



0 dB = 127.5 = 42.11 dB

Plot 18 T-Coil LTE Band 12 Z Axial

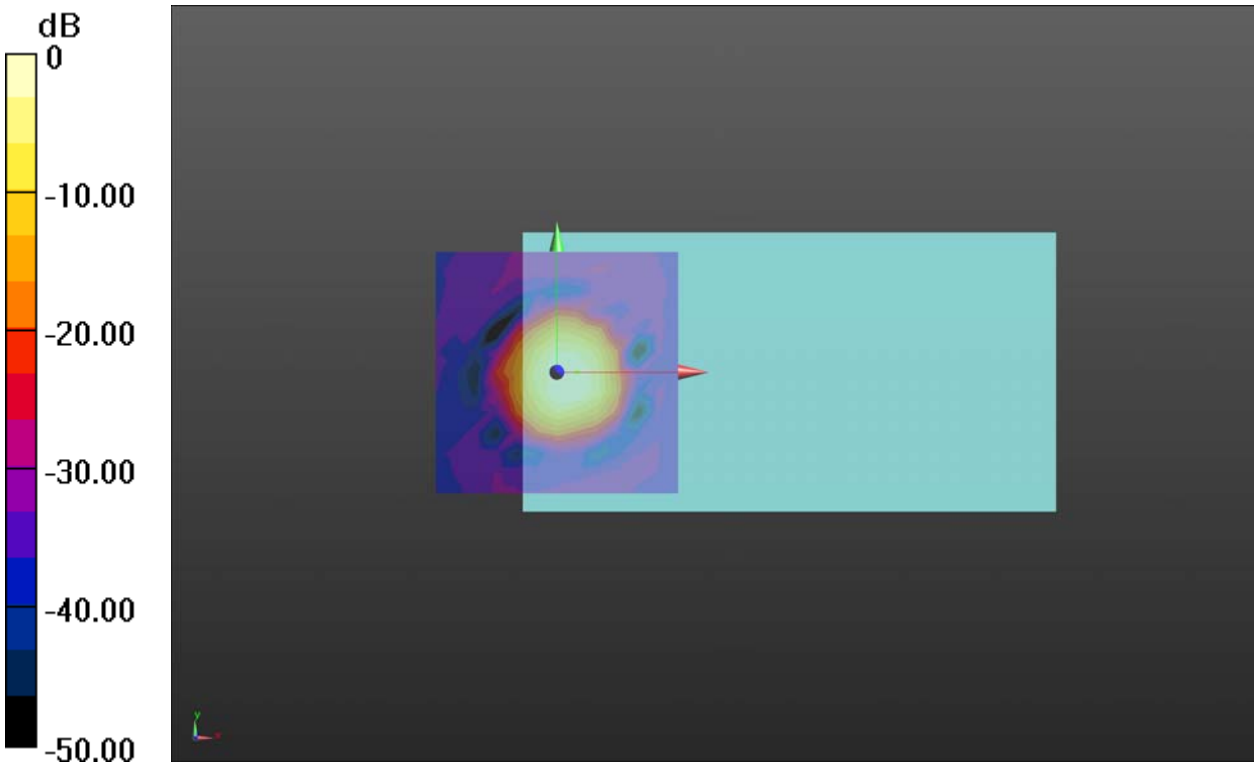
Date: 2022/2/7
Communication System: UID 10175 - CAG, LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK); Frequency: 707.5 MHz;Duty Cycle: 1:3.73594
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3
Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 2021/2/23
Electronics: DAE4 SN1692; Calibrated: 2021/10/4
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

LTE B5 1RB HAC_TCoil_WD_Emission-4.75kbps/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

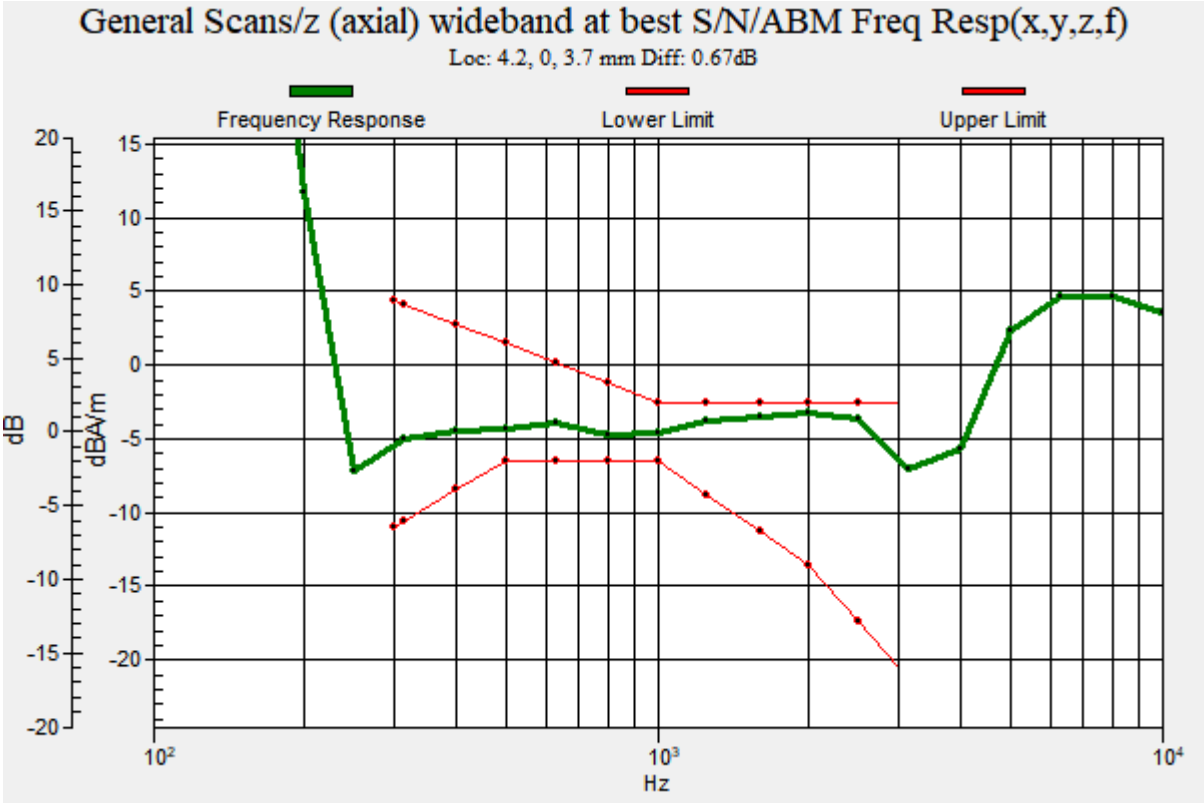
Cursor:
ABM1/ABM2 = 50.23 dB
ABM1 comp = -1.63 dBA/m
BWC Factor = 0.16 dB
Location: 4.2, 0, 3.7 mm

LTE B5 1RB HAC_TCoil_WD_Emission-4.75kbps/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 = 0.67 dB
BWC Factor = 10.81 dB
Location: 4.2, 0, 3.7 mm



0 dB = 324.6 = 50.23 dB



Plot 19 T-Coil LTE Band 66 Y transversal

Date: 2022/2/7

Communication System: UID 10169 - CAE, LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 1745 MHz;Duty Cycle: 1:3.73852

Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: TCoil Section

DASY5 Configuration:

Sensor-Surface: 0mm (Mechanical Surface Detection)

Probe: AM1DV3 - 3082; Calibrated: 2021/2/23

Electronics: DAE4 SN1692; Calibrated: 2021/10/4

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

Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

LTE B66 1RB HAC_TCoil_WD_Emission-4.75kbps/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

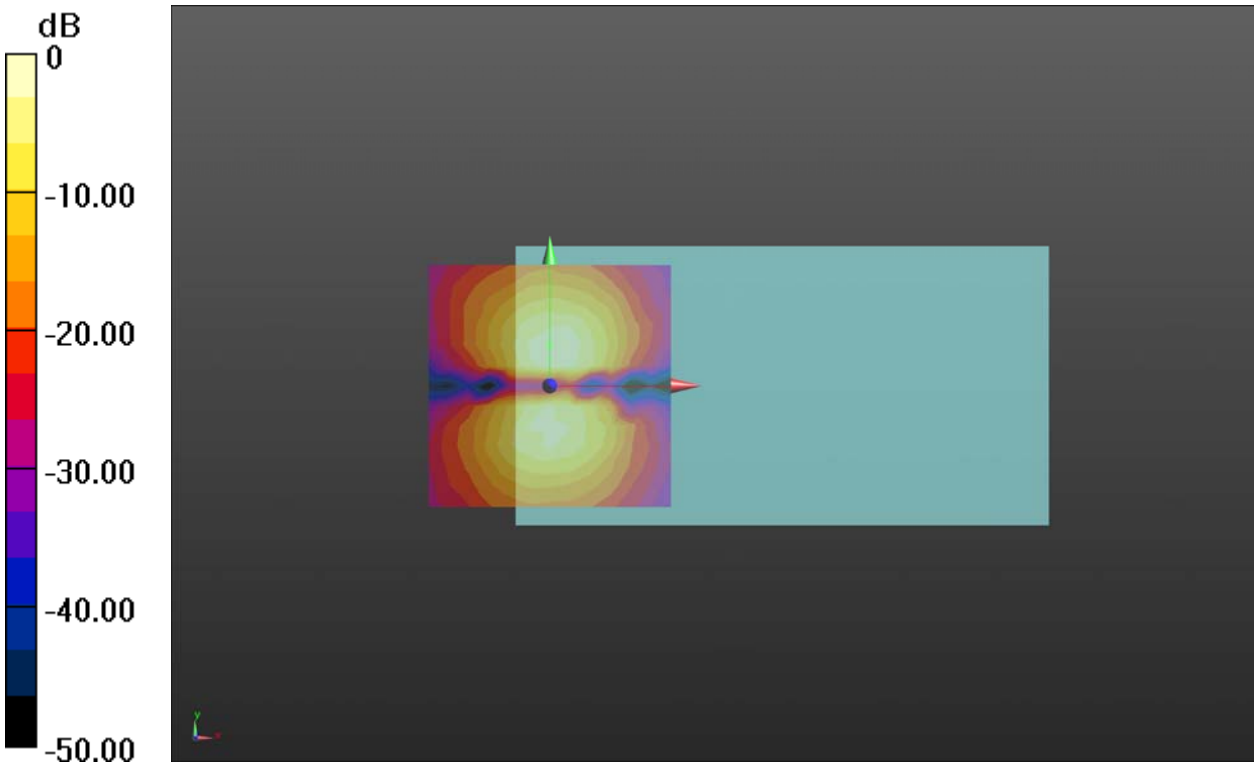
Cursor:

ABM1/ABM2 = 43.00 dB

ABM1 comp = -7.49 dBA/m

BWC Factor = 0.16 dB

Location: 0, 8.3, 3.7 mm



0 dB = 141.2 = 43.00 dB

Plot 20 T-Coil LTE Band 66 Z Axial

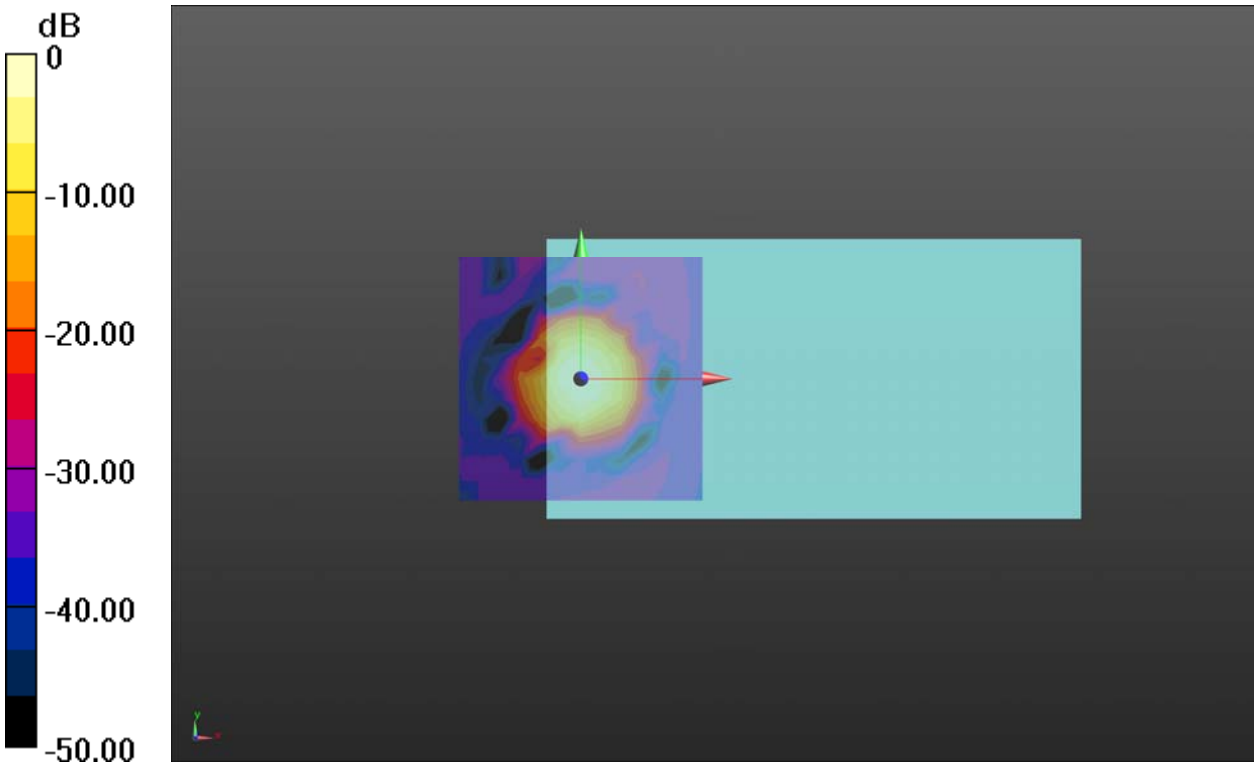
Date: 2022/1/25
Communication System: UID 10169 - CAE, LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 1745 MHz;Duty Cycle: 1:3.73852
Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1 kg/m^3
Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃
Phantom section: TCoil Section
DASY5 Configuration:
Sensor-Surface: 0mm (Mechanical Surface Detection)
Probe: AM1DV3 - 3082; Calibrated: 2021/2/23
Electronics: DAE4 SN1692; Calibrated: 2021/10/4
Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

LTE B66 1RB HAC_TCoil_WD_Emission-4.75kbps/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

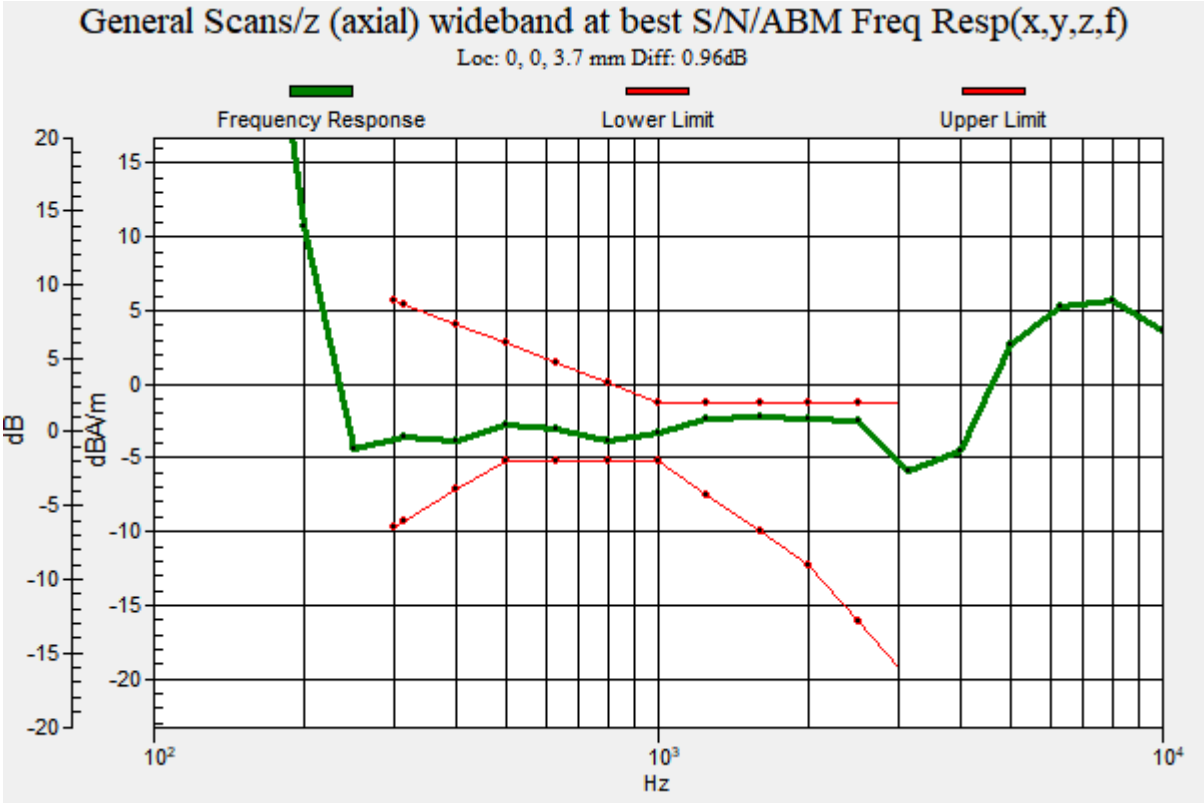
Cursor:
ABM1/ABM2 = 49.24 dB
ABM1 comp = -2.30 dBA/m
BWC Factor = 0.16 dB
Location: 0, 0, 3.7 mm

LTE B66 1RB HAC_TCoil_WD_Emission-4.75kbps/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 = 0.96 dB
BWC Factor = 10.81 dB
Location: 0, 0, 3.7 mm



0 dB = 289.6 = 49.24 dB



ANNEX C: Probe Calibration Certificate (February 23, 2021)

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_Feb21**

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:	February 23, 2021

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	07-Sep-20 (No. 28647)	Sep-21
Reference Probe AM1DV2	SN: 1008	15-Dec-20 (No. AM1DV2-1008_Dec20)	Dec-21
DAE4	SN: 781	23-Dec-20 (No. DAE4-781_Dec20)	Dec-21

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
AMCC	SN: 1050	01-Oct-13 (in house check Oct-20)	Oct-23
AMMI Audio Measuring Instrument	SN: 1062	26-Sep-12 (in house check Oct-20)	Oct-23

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

Issued: February 23, 2021

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

Certificate No: AM1DV3-3082_Feb21 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.

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, Zurich, Switzerland

Calibration data

Connector rotation angle	(in DASY system)	**8.8 °**	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	**0.91 °**	+/- 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%.

Certificate No: AM1DV3-3082_Feb21 Page 3 of 3

ANNEX D: Probe Calibration Certificate (February 23, 2022)

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: AM1DV3-3082_Feb22**

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: February 23, 2022

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-21 (No. 31368)	Aug-22
Reference Probe AM1DV2	SN: 1008	28-Dec-21 (No. AM1DV2-1008_Dec21)	Dec-22
DAE4	SN: 781	22-Dec-21 (No. DAE4-781_Dec21)	Dec-22

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
AMCC	SN: 1050	01-Oct-13 (in house check Oct-20)	Oct-23
AMMI Audio Measuring Instrument	SN: 1062	26-Sep-12 (in house check Oct-20)	Oct-23

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Niels Kuster	Quality Manager	

Issued: February 28, 2022

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

Certificate No: AM1DV3-3082_Feb22 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-C63.19-2019 (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.

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, Zurich, Switzerland

Calibration data

Connector rotation angle	(in DASY system)	**8.7 °**	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	**0.58 °**	+/- 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 E: DAE4 Calibration Certificate

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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Accreditation No.: **SCS 0108**

Client **TA-SH (Auden)**

Certificate No: **DAE4-1692_Oct21**

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BO - SN: 1692
Calibration procedure(s)	QA CAL-06.v30 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	October 04, 2021

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-21 (No:31368)	Aug-22
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-21 (in house check)	In house check: Jan-22
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-21 (in house check)	In house check: Jan-22

	Name	Function	Signature
Calibrated by:	Adrian Gehring	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	

Issued: October 4, 2021

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Certificate No: DAE4-1692_Oct21 Page 1 of 5

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

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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	404.451 ± 0.02% (k=2)	404.531 ± 0.02% (k=2)	404.388 ± 0.02% (k=2)
Low Range	3.95023 ± 1.50% (k=2)	4.00333 ± 1.50% (k=2)	3.97913 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	334.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199998.31	2.10	0.00
Channel X	+ Input	20004.35	2.07	0.01
Channel X	- Input	-19997.45	4.22	-0.02
Channel Y	+ Input	199996.63	0.87	0.00
Channel Y	+ Input	20001.14	-1.08	-0.01
Channel Y	- Input	-20002.28	-0.47	0.00
Channel Z	+ Input	199998.12	1.98	0.00
Channel Z	+ Input	20002.54	0.26	0.00
Channel Z	- Input	-20001.19	0.53	-0.00

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.64	0.32	0.02
Channel X	+ Input	202.20	0.58	0.29
Channel X	- Input	-197.54	0.78	-0.39
Channel Y	+ Input	1999.35	-1.87	-0.09
Channel Y	+ Input	200.36	-1.25	-0.62
Channel Y	- Input	-199.29	-0.98	0.49
Channel Z	+ Input	2000.89	-0.32	-0.02
Channel Z	+ Input	200.91	-0.59	-0.29
Channel Z	- Input	-199.57	-1.16	0.58

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	15.85	13.56
	- 200	-12.16	-14.19
Channel Y	200	21.51	20.97
	- 200	-24.04	-24.35
Channel Z	200	-6.87	-7.13
	- 200	6.28	5.75

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	-	-0.88	-2.39
Channel Y	200	6.27	-	2.31
Channel Z	200	8.86	3.02	-

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	15949	15587
Channel Y	15899	16465
Channel Z	15625	15999

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	1.24	-0.39	2.50	0.44
Channel Y	-0.70	-1.86	0.77	0.48
Channel Z	-0.23	-1.42	0.54	0.37

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 F: The EUT Appearances and Test Configuration

EUT

Picture 2: Constituents of EUT

Picture 3: Test Setup