Hearing Aid Compatibility (HAC) T-Coil Test Report

APPLICANT	:	GREAT TALENT TECHNOLOGY LIMITED
PRODUCT NAME	:	Feature Phone
MODEL NAME	:	F30
BRAND NAME	:	F30
FCC ID	:	2ALZM-F30
STANDARD(S)	:	47CFR 20.19 ANSI C63.19-2011
RECEIPT DATE	:	2019-05-21
TEST DATE	:	2019-05-27
ISSUE DATE	:	2019-06-03

Edited by: Su Jinhai
Su Jinhai (Rapporteur)

Approved by: Peng Huarui
Peng Huarui (Supervisor)

DIRECTORY

Annex C Plots of T-Coil Test Results
Annex D DASY Calibration Certificate

Change History		
Version	**Date**	**Reason for change**
1.0	2019-06-03	First edition

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd.
FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road,
Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China
Tel: 86-755-36698555 Fax: 86-755-36698525
Http://www.morlab.cn E-mail: service@morlab.cn

1. Attestation of Testing Summary

Air Interface	Frequency Band	T-Rating	Frequency Response	Magnetic Intensity
CDMA CMRS Voice	BC0	T4	Pass	Pass
	BC1	T4	Pass	Pass
VoLTE	Band 2	T4	Pass	Pass
	Band 4	T4	Pass	Pass
	Band 5	T4	Pass	Pass
	Band 12	T4	Pass	Pass
	Band 13	T4	Pass	Pass
	Band 25	T4	Pass	Pass

2. Technical Information

Note: Provide by manufacturer.

2.1. Applicant and Manufacturer Information

Applicant:	GREAT TALENT TECHNOLOGY LIMITED
Applicant Address:	RM602,T3 Software Park,Hi-Tech Park South,Nanshan,Shenzhen, China
Manufacturer:	GREAT TALENT TECHNOLOGY LIMITED
Manufacturer Address:	RM602,T3 Software Park,Hi-Tech Park South,Nanshan,Shenzhen, China

2.2. Equipment under Test (EUT) Description

EUT Type:	Feature Phone
Hardware Version:	Q2803-V1.0
Software Version:	F30_V1.1.0
Frequency Bands:	CDMA BC0: 824.7MHz ~ 848.31MHz CDMA BC1: 1851.25MHz ~ 1908.75MHz LTE Band 2: 1850MHz ~ 1910MHz LTE Band 4: 1710MHz ~ 1755MHz LTE Band 5: 824MHz ~ 849MHz LTE Band 12: 699MHz ~ 716MHz LTE Band 13: 777MHz ~ 787MHz LTE Band 25: 1850MHz ~ 1915MHz WLAN: 2412 MHz ~2462 MHz Bluetooth: 2402 MHz ~2480 MHz
Modulation Mode:	CDMA2000 1XRTT: QPSK CDMA2000 1XEV-DO: QPSK LTE: QPSK/16QAM 802.11b: DSSS 802.11g/n-HT20/HT40: OFDM Bluetooth: GFSK, π/4-DQPSK, 8-DPSK
Antenna type:	PIFA Antenna
SIM cards description:	For Single SIM card version

2.3. Photographs of the EUT

Please refer to the External Photos for the Photos of the EUT

2.4. Applied Reference Documents

Leading reference documents for testing:

No.	Identity	Document Title
1	47 CFR§20.19	Hearing aid-compatible mobile handsets.
2	ANSI C63.19-2011	American National Standard Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids
3	KDB 285076 D01	HAC Guidance v05
4	KDB 285076 D02	T-Coil testing for CMRS IP v02

3. Air Interface and Operating Mode

<table>
<tr><th>Air Interface</th><th>Band</th><th>Transport Type</th><th>Simultaneous Transmitter</th><th>Name of Voice Service</th><th>Power Reduction</th></tr>
<tr><td rowspan="2">CDMA</td><td>BC0</td><td>VO</td><td>WLAN&BT</td><td>CMRS Voice</td><td>No</td></tr>
<tr><td>EVDO</td><td>DT</td><td>WLAN&BT</td><td>N/A</td><td>No</td></tr>
<tr><td rowspan="6">FDD-LTE</td><td>Band 2</td><td rowspan="6">VD</td><td rowspan="6">WLAN&BT</td><td rowspan="6">VoLTE</td><td>No</td></tr>
<tr><td>Band 4</td><td>No</td></tr>
<tr><td>Band 5</td><td>No</td></tr>
<tr><td>Band 12</td><td>No</td></tr>
<tr><td>Band 13</td><td>No</td></tr>
<tr><td>Band 25</td><td>No</td></tr>
<tr><td>WLAN</td><td>2450</td><td>DT</td><td>CDMA,LTE</td><td>N/A</td><td>No</td></tr>
<tr><td>BT</td><td>2450</td><td>DT</td><td>CDMA,LTE</td><td>N/A</td><td>No</td></tr>
<tr><td colspan="6">Where:
VO=Voice Only
DT=Digital Transport only
VD=CMRS and IP Voice Service over Digital Transport
BT=Bluetooth
* Ref Lev in accordance with 7.4.2.1 of ANSI C63.19-2011 and the July 2012 VoLTE interpretation
** Ref Lev −20 dBm0
*** Ref Lev XYNet established by KDB Inquiry NNNNNN @ −16 dBm0</td></tr>
</table>

Note:

1) **Air Interface/Band MHz:** List of all air interfaces and bands supported by the handset.
2) **Type: For each air interface, indicate the type of voice transport mode:**
   i. VO = legacy Cellular Voice Service, from Table 7.1 in 7.4.2.1 of ANSI C63.19-2011;
   ii. DT = Digital Transport only (no voice);
   iii. VD = IP Voice Service over Digital Transport.
3) **Simultaneous Transmitter:** Indicate any air interface/bands that operate in simultaneous or concurrent service transmission mode**.**
4) **Name of Voice Service:** See Q4 in 285076 D03 HAC FAQ for further clarification.
   a) Ref Lev in accordance with 7.4.2.1 of ANSI C63.19-2011 and the July 2012 VoLTE interpretation
   b) ** Ref Lev −20 dBm0
   c) *** Ref Lev XYNet established by KDB Inquiry NNNNNN @ −16 dBm0
5) **Power Reduction:** If the 1900 MHz band GSM air interface was tested using the option to

reduce the power, state in the test report the maximum power in the 1900 MHz band, and the reduced power used for testing compliance to demonstrate compliance to the requirement that power be reduced by no more than 2.5 dB.

4. Measurement standards for T-Coil

4.1. T-Coil Signal Quality Categories

This sub clause specifies the signal-to-noise quality requirement for the intended T-Coil signal from a WD. The worst signal to noise of the two T-Coil signal measurements, as determined in Clause 7, shall be used to determine the T-Coil mode category per Table 2.1.

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 criterion that can be measured is the RF immunity in T-Coil mode. The RF measurements made for the T-Coil evaluation are used to assign the category T1 through T4. The limitation is given in Table 1. This establishes the RF environment presented by the WD to a hearing aid.

Category	Telephone parameters WD signal quality [(signal + noise)-to-noise ratio in 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

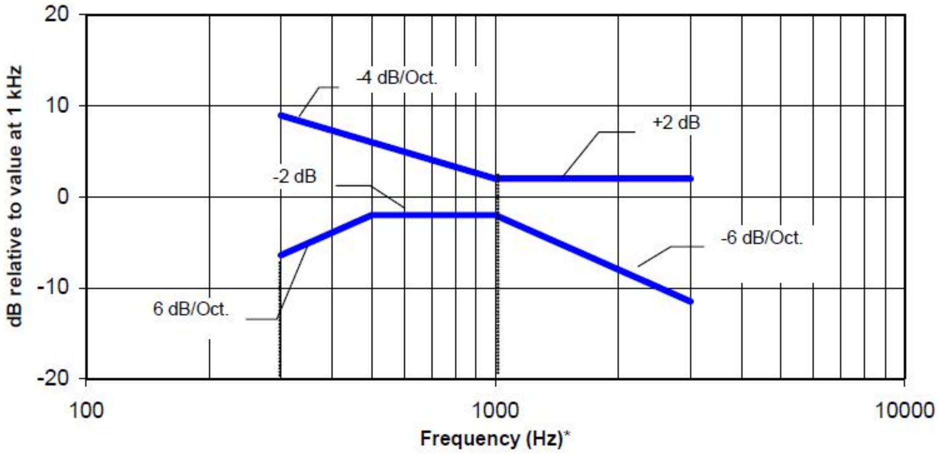
Table 2.1 T-Coil signal-to-noise categories

4.2. Frequency Response

This sub clause describes the relationship between the M rating, which is based on the RF emission tests performed in Clause 5, and the T rating, which is based on the T-Coil tests performed in Clause 7.

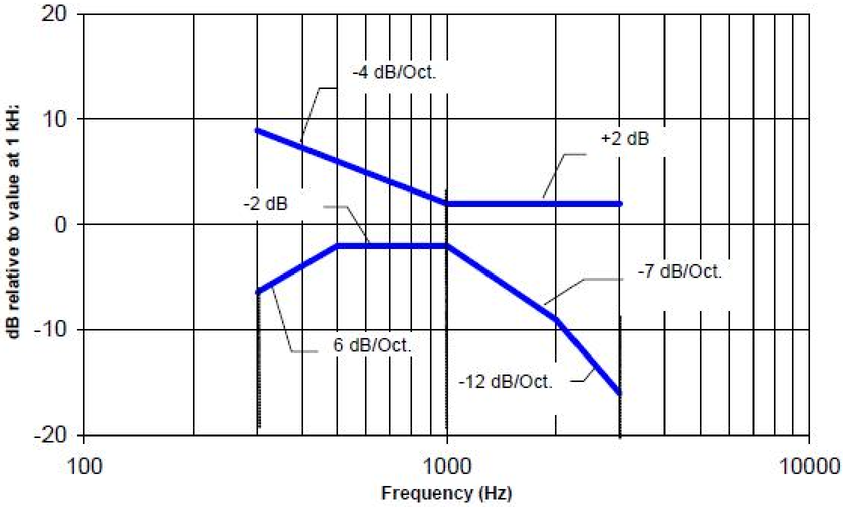
If the WD achieves an acceptable category rating per ANSI C63.19-2011 section 8.2, as determined by the appropriate regulating authority, it becomes a candidate for the T designation (see ANSI C63.19-2011 section 8.3.4).

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



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

Fig 2.1 Magnetic field frequency response for WDs with field strength ≤ –15 dB (A/m) at 1 kHz



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

Fig 2.2 Magnetic field frequency response for WDs with a field that exceeds –15 dB(A/m) at 1 kHz

5. HAC (T-Coil) Measurement System

5.1. T-Coil Measurement Setup

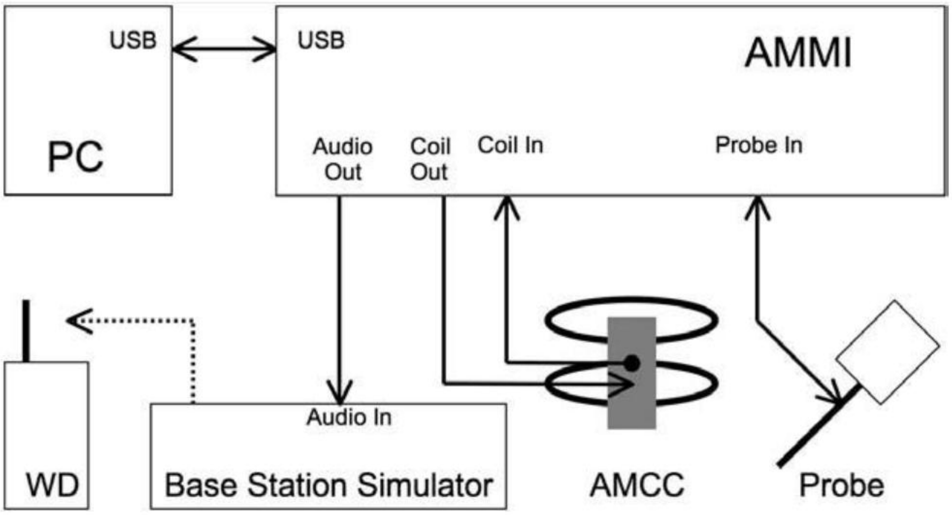


Fig 5.1 SPEAG T-Coil System Configurations

Note:

1、Per C63 & KDB 285076 D02v03, define the all applicable input audio level:

1) GSM input level: -16dBm0
2) UMTS input level: -16dBm0
3) VoLTE input level: -16dBm0
4) VoWiFi input level: -20dBm0
5) OTT Voip input level: -20dBm0

2、A communication base station CMU200 is used for testing GSM / UMTS / CDMA, and it's "Decode Cal" and "Codec Cal" with audio option B52 and B85 to set the correct audio input level.

3、CMU200 is able to output 1KHz audio signal equivalent to 3.14dBm0 at "Decode Cal", the signal reference is used to adjust the AMMI gain setting to reach -16dBm0 for GSM/UMTS and -18dBm0 for CDMA.

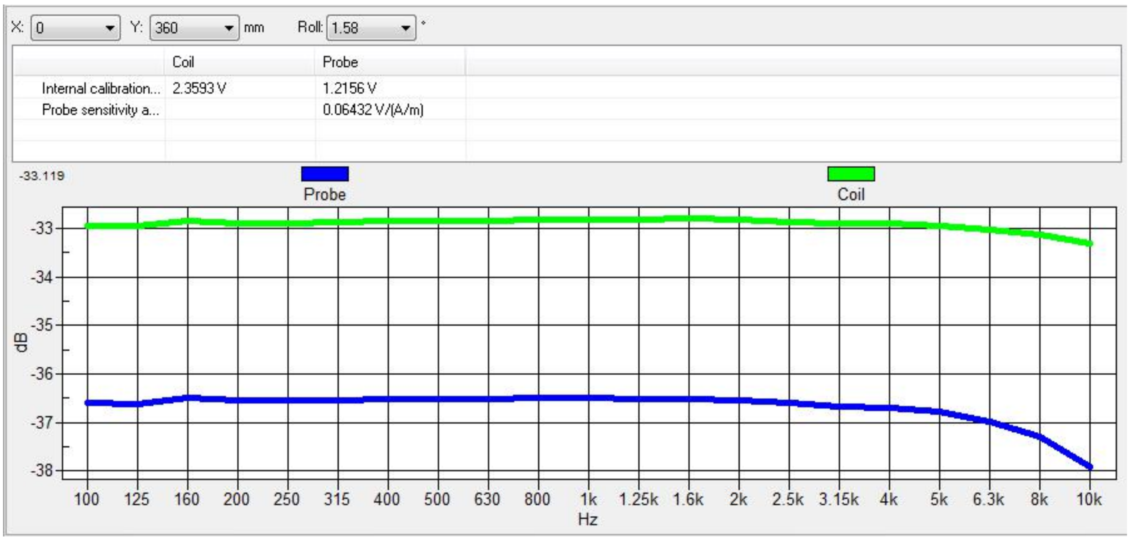
4、The callbox of CMW500 is used for VoLTE over IMS and VoWiFi over IMS T-Coil measurement, the data application unit of the CMW500 was used to simulate the IP multimedia subsystem server. And the CMW500 can be manually configured to ensure and control the speech input level result is -16dBm0 for VoLTE and -20dBm0 for VoWiFi when the device during the IMS connection.

5、The OTT VOIP call is tested on the data application unit of CMW500 connection to the internet.

5.2. System Validation

For correct and calibrated measurement of the voltages and ABM filed, DASY will perform a calibration job follows below:

1. In phase 1, the audio output is switched off, and a 200 mW symmetric rectangular signal of 1 kHz is connected directly to both channels of the sampling unit(Coil in, Probe in).
2. In phase 2, the audio output is off, and a 20 mW symmetric 100 Hz signal is internally connected. The signals during phases 1 and 2 are available at the output on the rear panel of the AMMI. However, the output must not be loaded, in order to avoid influencing the calibration, an RMS voltmeter would indicate 100mWRMS, during the second phase after the first two phases, the two input channels are both calibrated for absolute ants of voltages. The resulting factors are displayed above the multi-meter window.
3. After phases 1 and 2, the input channels are calibrated to measure exact voltages. This is required to use the inputs for measuring voltages with their peak and RMS value.
4. In phase 3, a mulit-sine signal covering each third-octave band from 50 Hz to 10 kHz is generated and applied to both audio outputs. The probe should be positioned in the center of the AMCC and aligned in the z-direction, the filed orientation of the AMCC. The "Coil In" channel is measuring the voltage over the AMCC internal shunt, which is proportional to the magnetic filed in the AMCC. At the same time, the "Probe In" channel samples the amplified signal picked up by the probe coil and provides a numerical integrator. The radio of two voltages in each third-octave filter leads to the spectral representation over the frequency band of interest. The coil signal is scaled in dBV, and the probe signal is first integrated and normalized to show dB A/m. The radio probe-to-coil at the frequency of 1KHz is the sensitivity which will be used in the consecutive T-coil jobs,.
5. The ABM validation during testing as below.



5.3. Base Station Gain Factor

1. The Required gain factor for the specific signal shall typically be multiplied by this factor to achieve approx. the same level as for the 1kHz sine signal.
2. The calculation formula as below showing how to determine the input level for air interface for this device.

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.

CMU200 for CDMA

<Input level determination >

Gain Value	20* log(gain)	AMCC Coil in	Level
(linear)	dB	(dBv RMS)	dBm0
		-2.44	3.14
10	20	-20.96	-15.38
7.40	17.38	-23.58	-18

<Base station gain factor calculation>

Signal Type	Duration (s)	Peak to RMS (dB)	RMS (dB)	Gain Factor	Gain Setting
1kHz sine	-	3	0	1	8.17
48k_voice_1kHz	1	16.2	-12.7	4.33	32.02
48k_voice_300-3000	2	21.6	-18.6	8.48	62.72

CMW500 for VoLTE

<Input level determination >

Gain Value	dBm	Full scal Voltage	dB	AMMI audio out (dBv) (RMS)	AMCC Coil Out (dBv) (RMS)
	3.14	1.5		0.51	
100	5.61		40	2.98	3.13
8.31	-16		18.39		-18.48

<Base station gain factor calculation>

Signal Type	Duration (s)	Peak to RMS (dB)	RMS (dB)	Gain Factor	Gain Setting
48k_voice_1kHz	1	16.2	-12.7	4.33	35.98
48k_voice_300-3000	2	21.6	-18.6	8.48	70.46

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd.
FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road,
Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China
Tel: 86-755-36698555 Fax: 86-755-36698525
Http://www.morlab.cn E-mail: service@morlab.cn

6. T-Coil Measurement Procedure

6.1. General Guidance

T-Coil measurement follows ANSI C63.19-2011, Section 7.4

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

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

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

The following steps summarize the basic test flow for determining ABM1 and ABM2. These steps assume that a sine wave or narrowband 1/3 octave signal can be used for the measurement of ABM1.

1) A validation of the test setup and instrumentation may be performed using a TMFS or Helmholtz coil Measure the emissions and confirm that they are within the specified tolerance.
2) Position the WD in the test setup and connect the WD RF connector to a base station simulator or a non-radiating load. Confirm that equipment that requires calibration has been calibrated, and that the noise level meets the requirements given in ANSI C63.19-2011 clause 7.3.1.
3) The drive level to the WD is set such that the reference input level specified in ANSI C63.19-2011 Table 7.1 is input to the base station simulator (or manufacturer's test mode equivalent) in 1 kHz, 1/3 octave

band. This drive level shall be used for the T-Coil signal test (ABM1) at f = 1 kHz. Either a sine wave at 1025 Hz or a voice-like signal, band-limited to the 1 kHz 1/3 octave, as defined in ANSI C63.19-2011 clause 7.4.2, shall be used for the reference audio signal. If interference is found at 1025 Hz an alternative nearby reference audio signal frequency may be used. The same drive level shall be used for the ABM1 frequency response measurements at each 1/3 octave band center frequency. The WD volume control may be set at any level up to maximum, provided that a signal at any frequency at maximum modulation would not result in clipping or signal overload.

4) Determine the magnetic measurement locations for the WD device (A.3), if not already specified by the manufacturer, as described in ANSI C63.19-2011 clause 7.4.4.1.1 and 7.4.4.2.
5) At each measurement location, measure and record the desired T-Coil magnetic signals (ABM1 at fi) as described in ANSI C63.19-2011 clause 7.4.4.2 in each individual ISO 266-1975 R10 standard 1/3 octave band. The desired audio band input frequency (fi) shall be centered in each 1/3 octave band maintaining the same drive level as determined in item c) and the reading taken for that band. Equivalent methods of determining the frequency response may also be employed, such as fast Fourier transform (FFT) analysis using noise excitation or input-output comparison using simulated speech. The full-band integrated probe output, as specified in D.9, may be used, as long as the appropriate calibration curve is applied to the measured result, so as to yield an accurate measurement of the field magnitude. (The resulting measurement shall be an accurate measurement in dB A/m.)
6) All Measurements of the desired signal shall be shown to be of the desired signal and not of an undesired signal. This may be shown by turning the desired signal ON and OFF with the probe measuring the same location. If the scanning method is used the scans shall show that all measurement points selected for the ABM1 measurement meet the ambient and test system noise criteria in ANSI C63.19-2011 clause 7.3.1.
7) At the measurement location for each orientation, measure and record the undesired broadband audio magnetic signal (ABM2) as specified in ANSI C63.19-2011 clause 7.4.4.4 with no audio signal applied (or digital zero applied, if appropriate) using A-weighting and the half-band integrator. Calculate the ratio of the desired to undesired signal strength (i,e., signal quality). Obtain the data from the postprocessor, SEMCAD, and determine the category that properly classifies the signal quality based on ANSI C63.19-2011 Table 8.5.

6.2. T-Coil Test Flow

This section follows ANSI C63.19-2011 section 7.4.1:

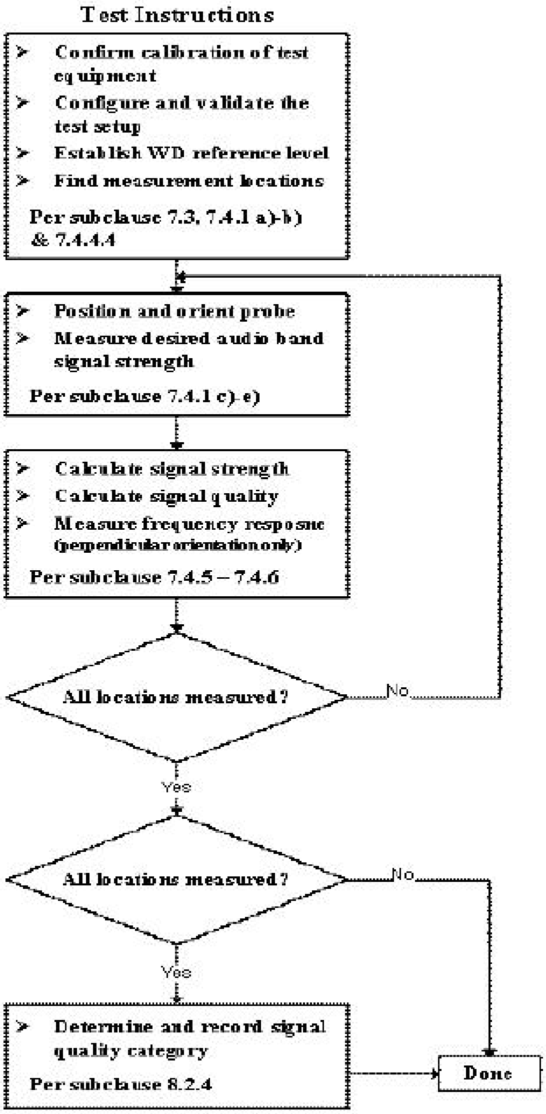


Fig 6.1 WD T-Coil signal test flowchart

6.3. Information of EUT Test Position

Fig2.2 illustrates the measurement locations and reference plane to be used for the T-Coil measurements. And measurement setup follows:

1、The scan area is 5cm*5cm.

2、The area is centered on the audio frequency output transducer of the EUT.

3、The area is in a reference plane, which is defined as the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It's 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, rests against the ear.

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

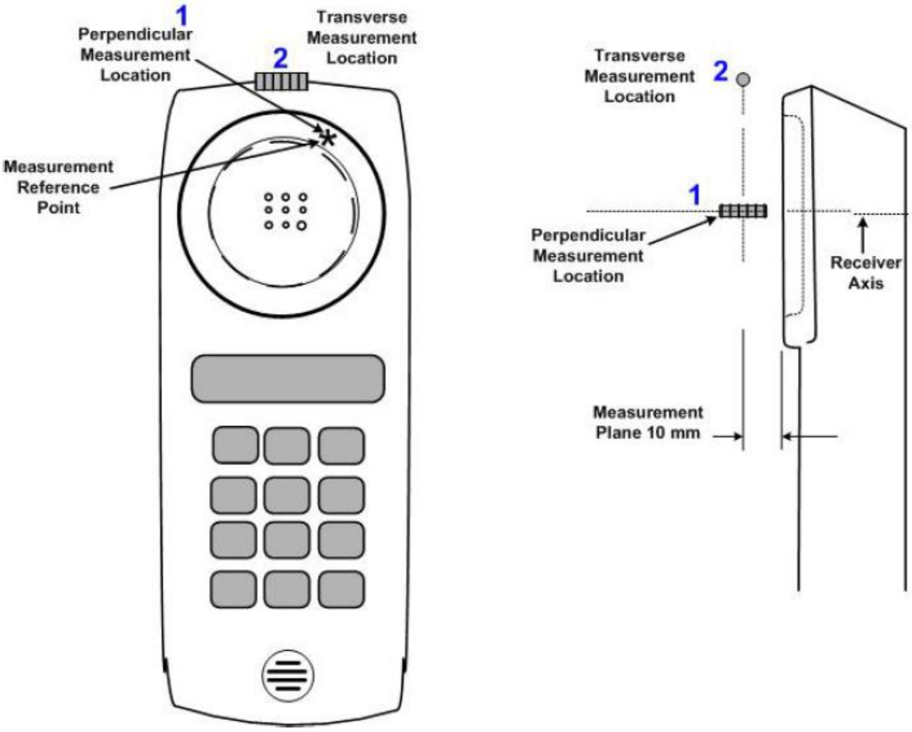


Fig6.2 A typical EUT reference and plane for T-Coil measurement

7. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Audio Magnetic 1D Field Probe	AM1DV2	1048	2018-11-24	2019-11-23
SPEAG	Audio Magnetic Calibration Coil	AMCC	1044	NCR	NCR
SPEAG	Audio Measuring Instrument	AMMI	1032	NCR	NCR
SPEAG	Audio Holder	N/A	1094	NCR	NCR
SPEAG	Data Acquisition Electronics	DAE4	480	2018-10-29	2019-10-28
R&S	Network Emulator	CMU200	107082	2018.11.16	2019.11.15
R&S	Network Emulator	CMW500	124534	2019-04-17	2020-04-16
THERMOMETER	Thermo meter	DC-803	N/A	2018.11.22	2019.11.21

8. Summary Test Results

8.1. Test Guidance

1. The middle channel of each frequency band is used for T-Coil testing according ANSI C63.19 2011.
2. According to KDB 285076, reporting results involves a two-step process: (1) Codec Investigation to determine the worst-case codec for each voice service, and (2) Air Interface Investigation. Using the worst-case codec for a voice service, a range of channels and bands shall be tested.
3. It supports 2.4G wifi data mode of this device, therefore Vo-wifi measurement is not required in this report.

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd.
FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road,
Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China
Tel: 86-755-36698555 Fax: 86-755-36698525
Http://www.morlab.cn E-mail: service@morlab.cn

8.2. Test Results

<CDMA Mode>

Codec Investigation-air interface:

Air Interface	Modulation	Channel	Probe Position	ABM1 dB (A/m)	ABM2 dB (A/m)	Signal Quality (dB)
CDMA2000 BC0	RC1 SO1	384	Axial (Z)	4.56	-38.92	43.48
	RC1 SO3	384	Axial (Z)	**4.53**	**-38.90**	**43.43**
	RC1 SO68	384	Axial (Z)	4.62	-38.94	43.56

Note: Highlight part of test mode,1xRTT 1/8th for CDMA test rate .

Plot No.	Air Interface	Channel	Probe Position	ABM1 dB (A/m)	ABM2 dB (A/m)	Signal Quality (dB)	T Rating	Frequency Response
1	CDMA2000 BC0	384	Axial (Z)	4.53	-38.90	43.43	T4	Pass
			Transversal (Y)	2.93	-39.51	42.44	T4	
2	CDMA2000 BC1	600	Axial (Z)	5.27	-36.85	42.12	T4	Pass
			Transversal (Y)	-1.12	-43.25	42.13	T4	

<VoLTE Mode>

Codec Investigation-air interface:

Air Interface	Modulation	Channel	Probe Position	ABM1 dB (A/m)	ABM2 dB (A/m)	Signal Quality (dB)
LTE Band 2	**QPSK 1RB0 20MHz 12.2Kbps**	18900	Axial (Z)	**3.90**	**-43.58**	**47.48**
	QPSK 1RB0 20MHz 7.4Kbps		Axial (Z)	4.02	-43.48	47.50
	QPSK 1RB0 20MHz 4.75Kbps		Axial (Z)	4.11	-43.44	47.55

Note:

1. Select the maximum bandwidth QPSK modulation mode, the maximum power of 1RB configuration,worst rate to test.
2. Highlight part of test mode.

Plot No.	Air Interface	Mode	Channel	Probe Position	ABM1 dB (A/m)	ABM2 dB (A/m)	Signal Quality (dB)	T Rating	Frequency Response
3	LTE Band 2	1RB0 20MHz	18900	Axial (Z)	3.90	-43.58	47.48	T4	Pass
				Transversal (Y)	-5.52	-49.68	44.16	T4	
4	LTE Band 4	1RB0 20MHz	20175	Axial (Z)	5.22	-53.99	59.21	T4	Pass
				Transversal (Y)	-4.78	-49.63	44.85	T4	
5	LTE Band 5	1RB24 10MHz	20525	Axial (Z)	3.45	-44.37	47.82	T4	Pass
				Transversal (Y)	-6.11	-51.19	45.08	T4	
6	LTE Band 12	1RB0 20MHz	23095	Axial (Z)	4.00	-44.48	48.48	T4	Pass
				Transversal (Y)	-4.97	-49.77	44.80	T4	
7	LTE Band 13	1RB0 10MHz	23230	Axial (Z)	4.34	-44.09	48.43	T4	Pass
				Transversal (Y)	-5.07	-50.61	45.54	T4	
8	LTE Band 25	1RB0 10MHz	26365	Axial (Z)	4.43	-54.10	58.53	T4	Pass
				Transversal (Y)	-4.42	-49.31	44.89	T4	

9. Uncertainty Assessment

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) ABM1	(Ci) ABM2	Standard Uncertainty (ABM1) (±%)	Standard Uncertainty (ABM2) (±%)
Probe Sensitivity							
Reference level	3.0	N	1	1	1	3.0	3.0
AMCC geometry	0.4	R	1.732	1	1	0.2	0.2
AMCC current	1.0	R	1.732	0.7	0.7	0.6	0.6
Probe positioning during calibrate	0.1	R	1.732	1	1	0.1	0.1
Noise contribution	0.7	R	1.732	0.0143	1	0.0	0.4
Frequency slope	5.9	R	1.732	0.1	1	0.3	3.5
Probe System							
Repeatability/drift	1.0	R	1.732	1	1	0.6	0.6
Linearity/dynamic range	0.6	R	1.732	1	1	0.4	0.4
Acoustic noise	1.0	R	1.732	0.1	1	0.1	0.6
Probe angle	2.3	R	1.732	1	1	1.4	1.4
Spectral processing	0.9	R	1.732	1	1	0.5	0.5
Integration time	0.6	N	1	1	5	0.6	3.0
Field disturbation	0.2	R	1.732	1	1	0.1	0.1
Test Signal							
Reference signal spectral response	0.6	R	1.732	0	1	0.0	0.4
Positioning							
Probe positioning	1.9	R	1.732	1	1	1.1	1.1
Phantom thickness	0.9	R	1.732	1	1	0.5	0.5
EUT positioning	1.9	N	1	0.78	0.71	0.1	0.1
External contributions							
RF interference	0.0	R	1.732	1	0.3	0.0	0.0
Test signal variation	2.0	R	1.732	1	1	1.2	1.2
Combined Std. Uncertainty						4.1	6.1
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						8.1	12.3

Annex A General Information

1. Identification of the Responsible Testing Laboratory

Laboratory Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Laboratory Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

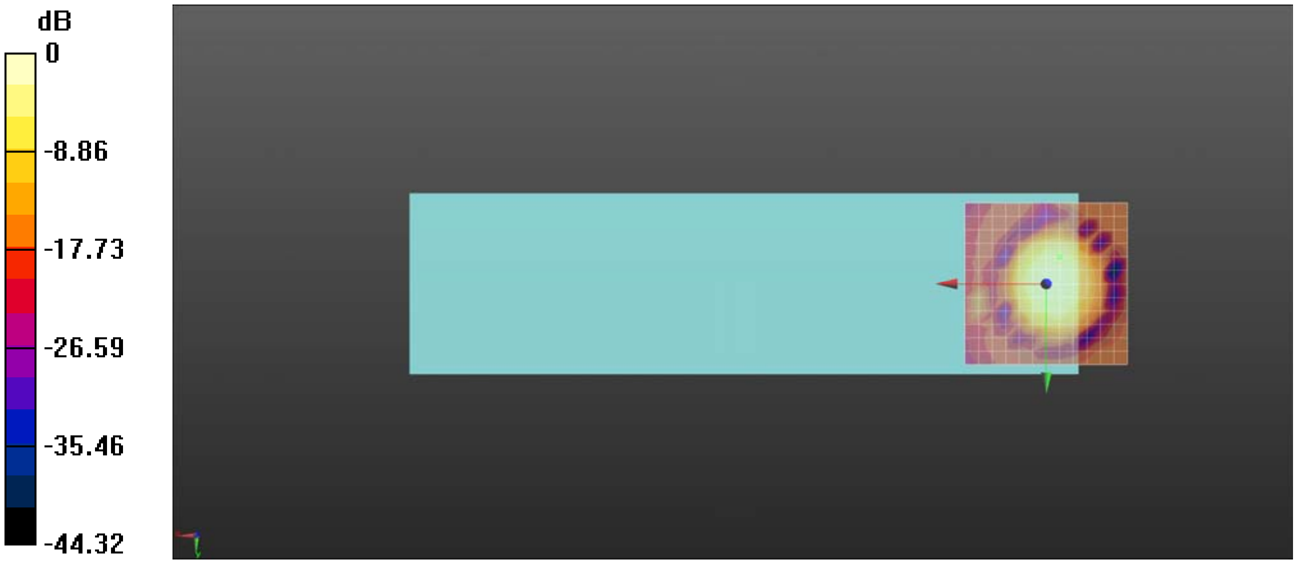
Annex C Plots of T-Coil Test Results

HAC_T-Coil_CDMA2000 BC0_RC1 SO3_Ch384_Z

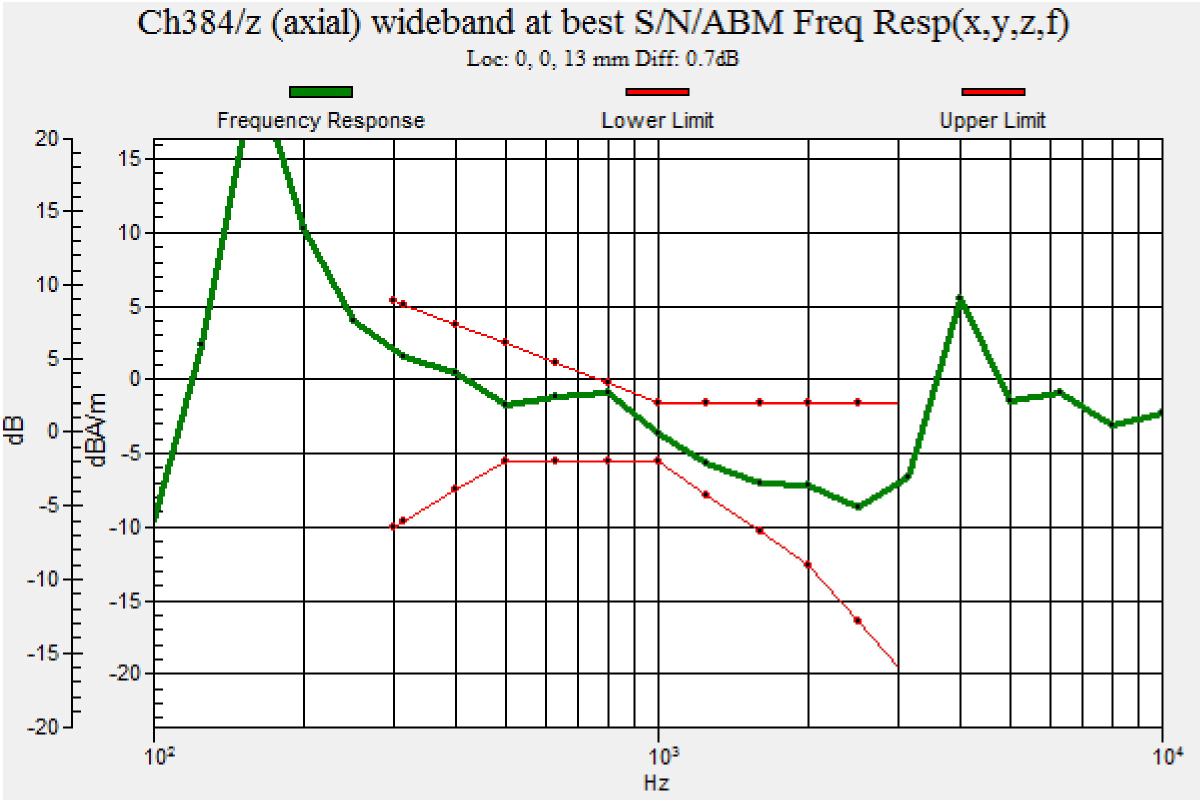
Communication System: UID 10295 - AAB, CDMA2000, RC1, SO3, 1/8th Rate 25 fr.; Frequency: 836.52 MHz;Duty Cycle: 1:17.7419
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch384/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 43.43 dB
ABM1 comp = 4.53 dBA/m
BWC Factor = 0.55 dB
Location: -4.2, -8.3, 3.7 mm



0 dB = 148.5 = 43.43 dB



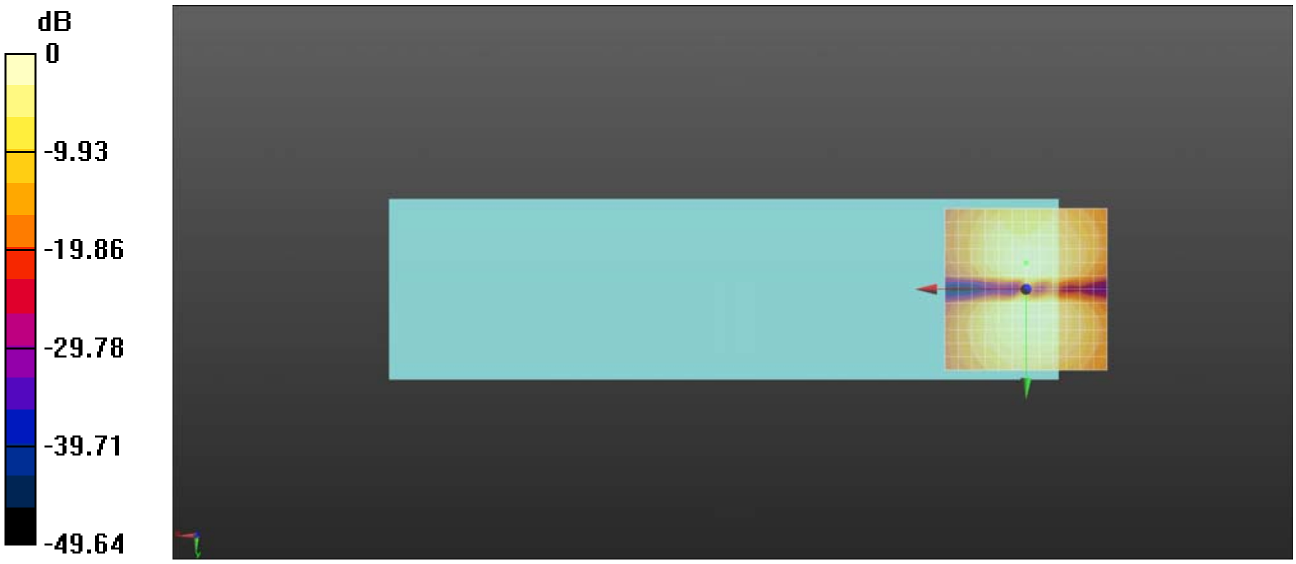
Ch384/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: 0, 0, 13 mm Diff: 0.7dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

HAC_T-Coil_CDMA2000 BC0_RC1 SO3_Ch384_Y

Communication System: UID 10295 - AAB, CDMA2000, RC1, SO3, 1/8th Rate 25 fr.; Frequency: 836.52 MHz;Duty Cycle: 1:17.7419
Medium: Air Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 0 kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch384/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 42.44 dB
ABM1 comp = 2.93 dBA/m
BWC Factor = 0.55 dB
Location: 0, -8.3, 3.7 mm



0 dB = 132.4 = 42.44 dB

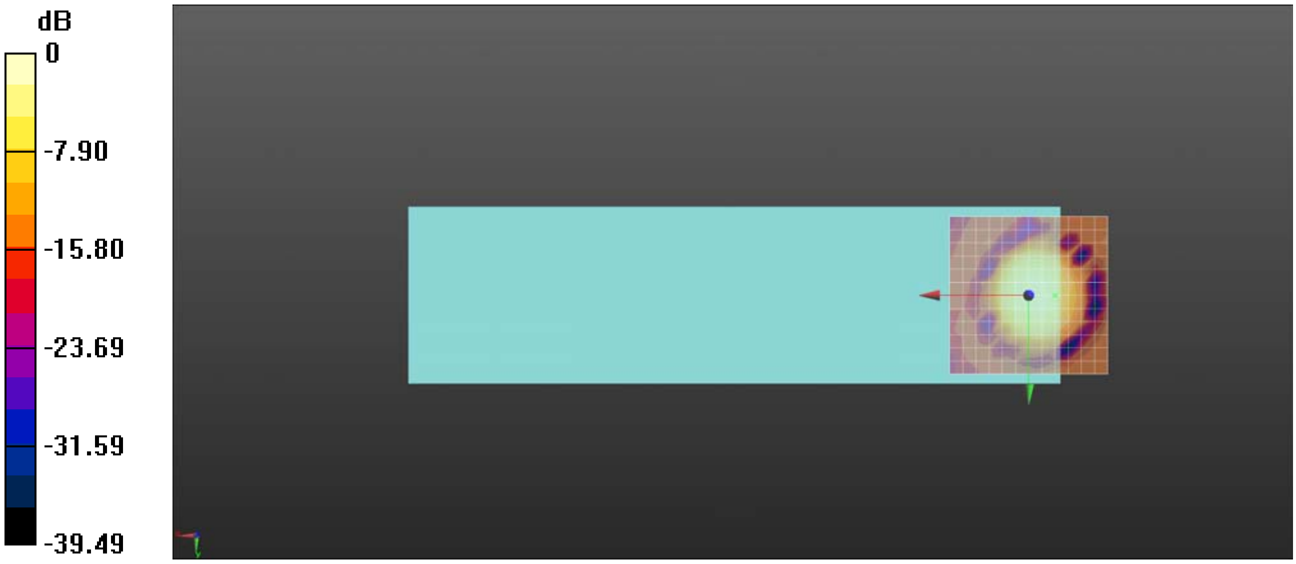
Test Laboratory: SAR Lab. of Shenzhen Morlab Communications Technology Co., Ltd. Date: 2019.05.27

HAC_T-Coil_CDMA2000 BC1_RC1 SO3_Ch600_Z

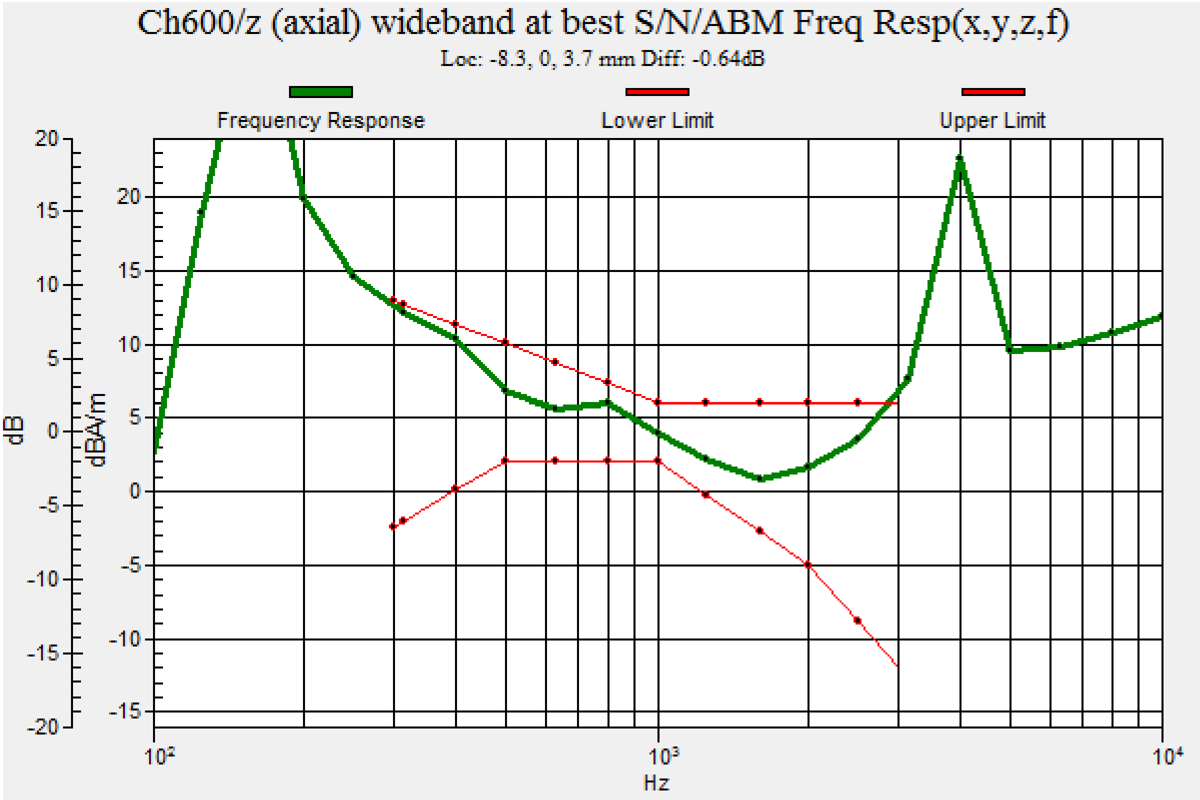
Communication System: UID 10295 - AAB, CDMA2000, RC1, SO3, 1/8th Rate 25 fr.; Frequency: 1880 MHz;Duty Cycle: 1:17.7419
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

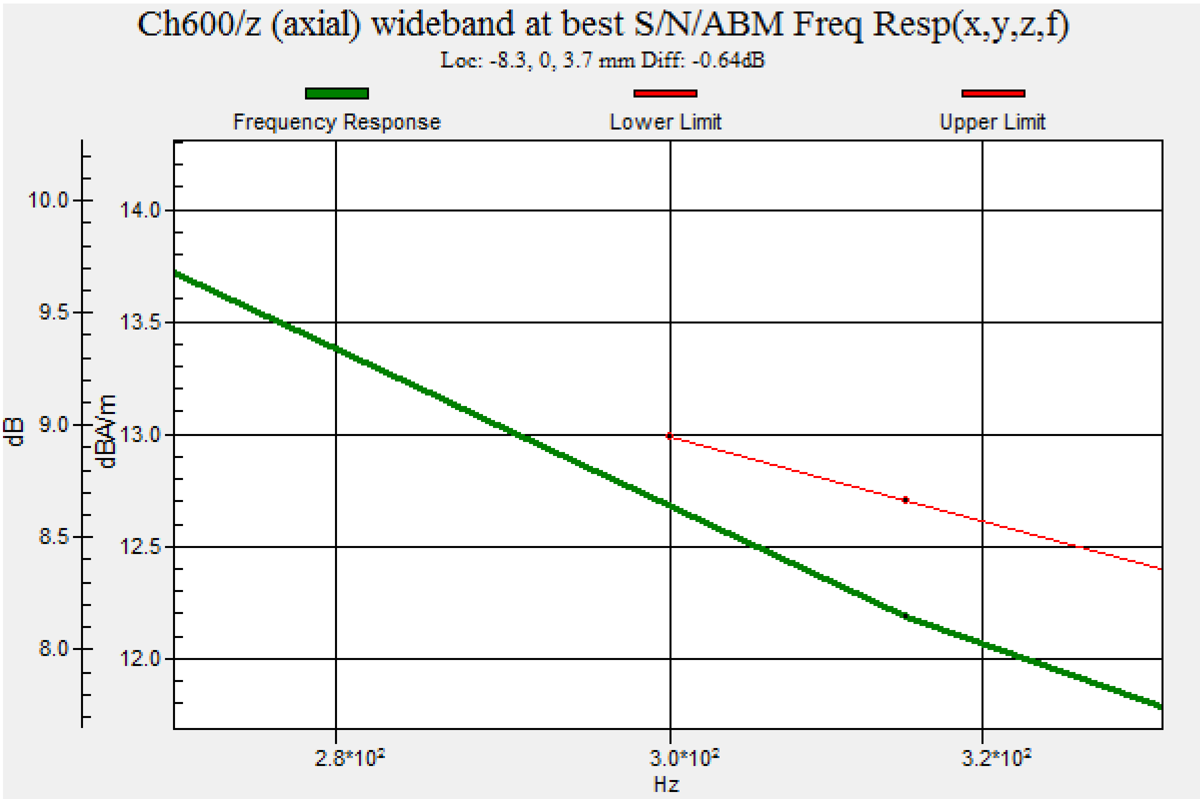
DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch600/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 42.12 dB
ABM1 comp = 5.27 dBA/m
BWC Factor = 0.24 dB
Location: -8.3, 0, 3.7 mm



0 dB = 127.6 = 42.12 dB


Ch600/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -8.3, 0, 3.7 mm Diff: -0.64dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

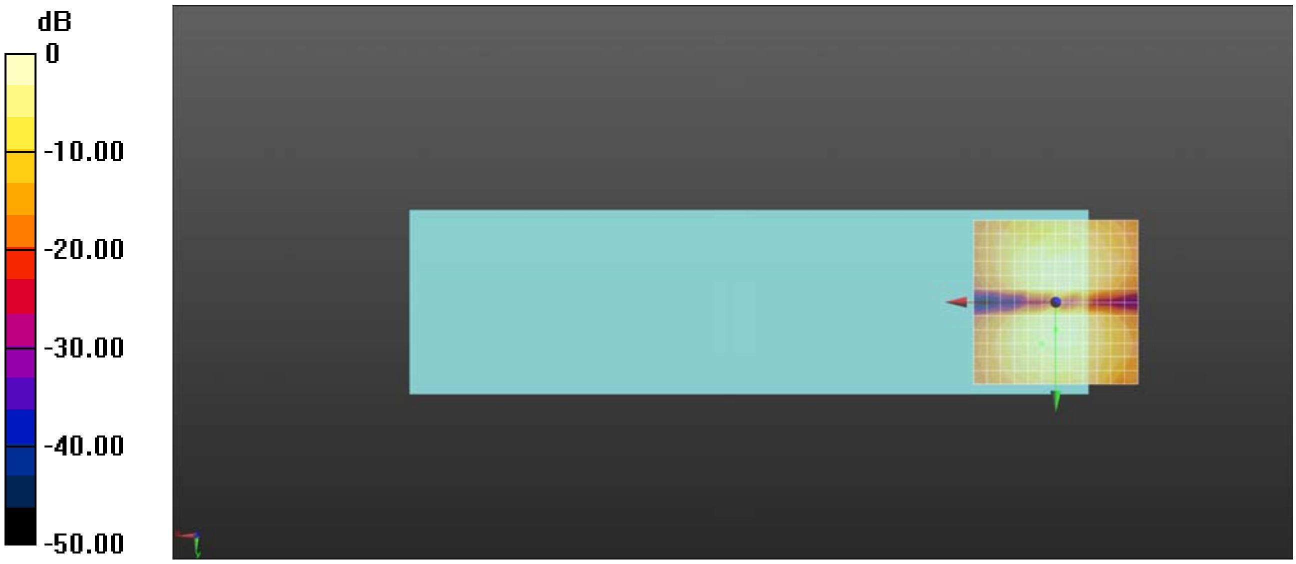

Ch600/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -8.3, 0, 3.7 mm Diff: -0.64dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

HAC_T-Coil_CDMA2000 BC1_RC1 SO3_Ch600_Y

Communication System: UID 10295 - AAB, CDMA2000, RC1, SO3, 1/8th Rate 25 fr.; Frequency: 1880 MHz;Duty Cycle: 1:17.7419
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch600/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 42.13 dB
ABM1 comp = -1.12 dBA/m
BWC Factor = 0.24 dB
Location: 4.2, 12.5, 3.7 mm



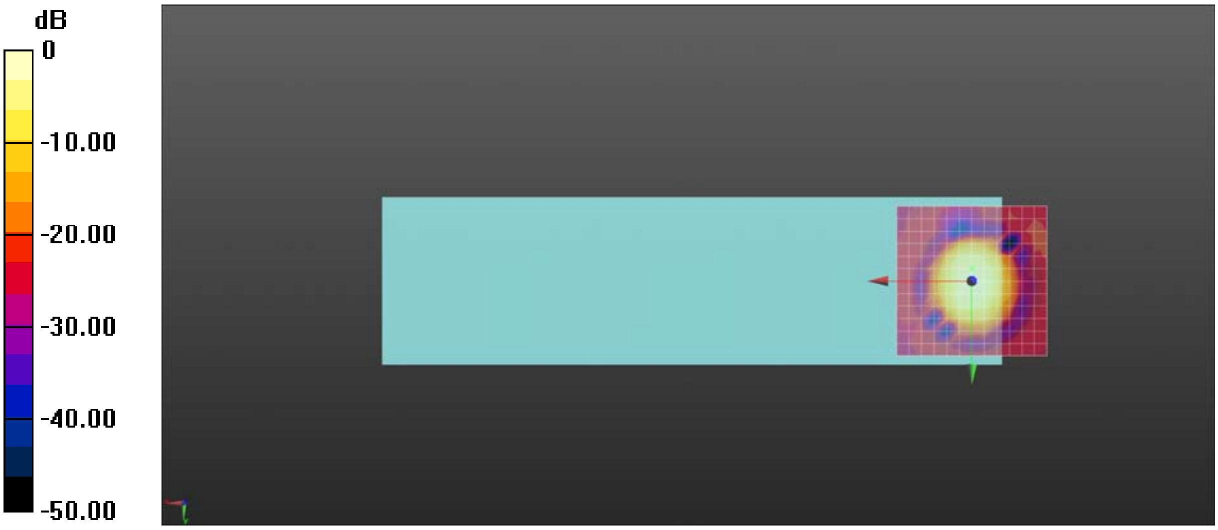
0 dB = 127.8 = 42.13 dB

HAC_T-Coil_LTE Band 2_20M_QPSK_1RB_0offset_12.2Kbps_Ch18900_Z

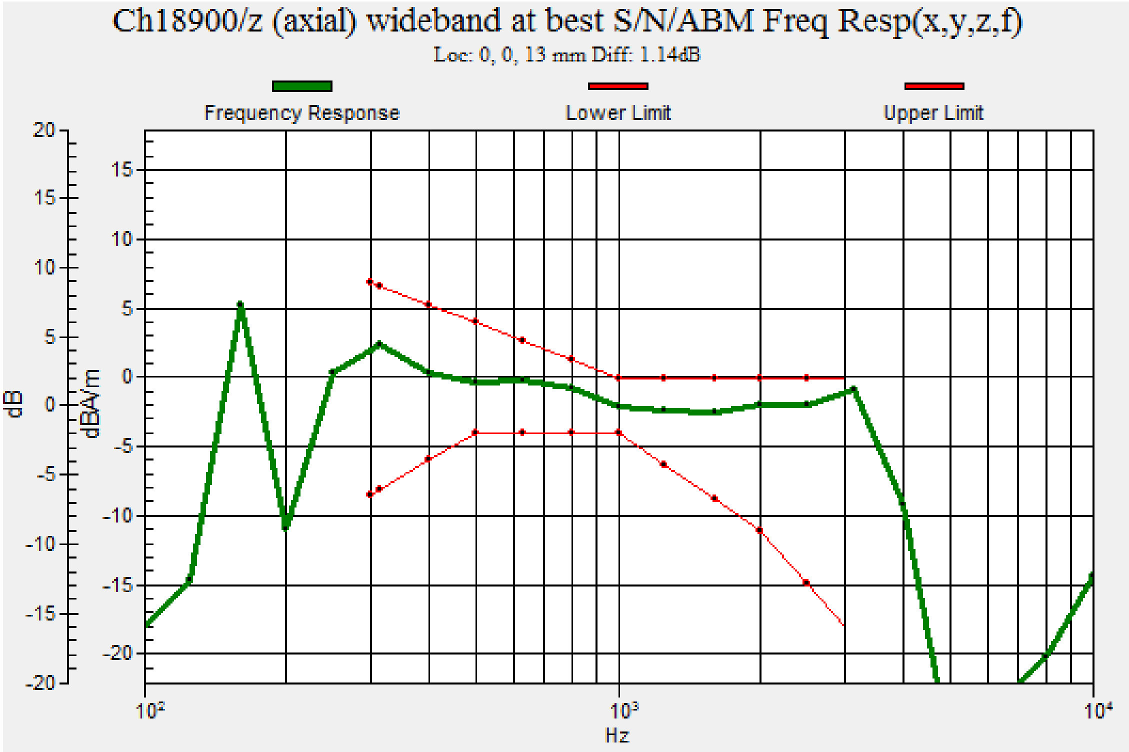
Communication System: UID 10169 - CAB, LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 1880 MHz;Duty Cycle: 1:3.74111
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch18900/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 47.48 dB
ABM1 comp = 3.90 dBA/m
BWC Factor = 0.30 dB
Location: 0, -4.2, 3.7 mm



0 dB = 236.5 = 47.48 dB



Ch18900/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: 0, 0, 13 mm Diff: 1.14dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

HAC_T-Coil_LTE Band 2_20M_QPSK_1RB_0offset_12.2Kbps_Ch18900_Y

Communication System: UID 10169 - CAB, LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK);
Frequency: 1880 MHz;Duty Cycle: 1:3.74111
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch18900/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 44.16 dB
ABM1 comp = -5.52 dBA/m
BWC Factor = 0.30 dB
Location: -4.2, -8.3, 3.7 mm

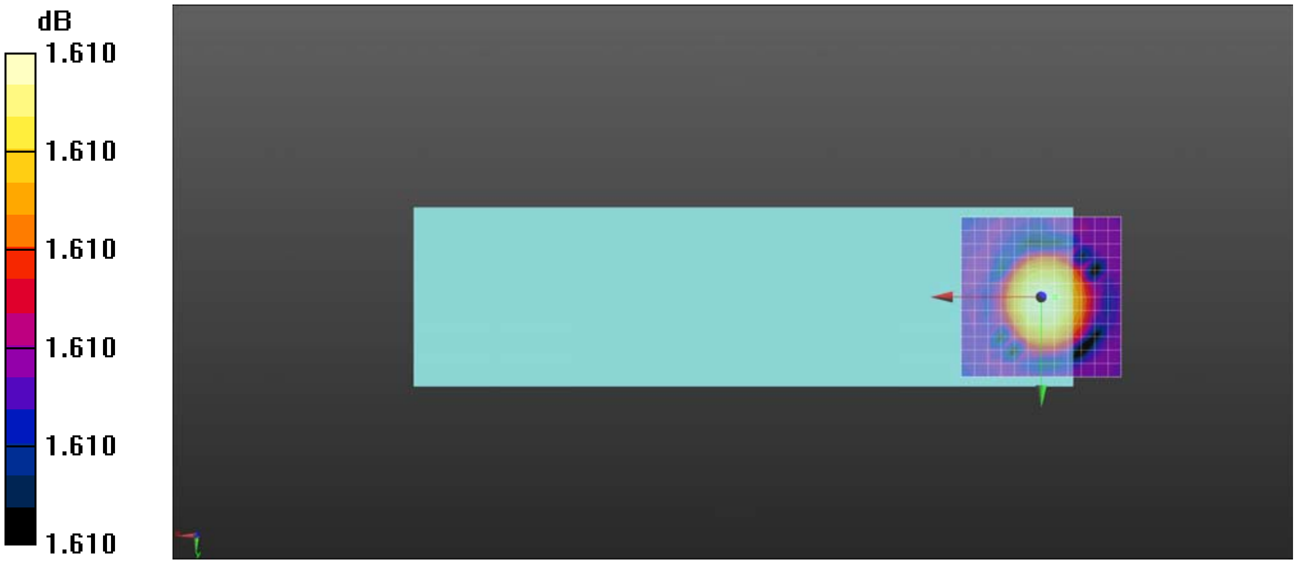
0 dB = 0.5314 A/m = -5.49 dBA/m

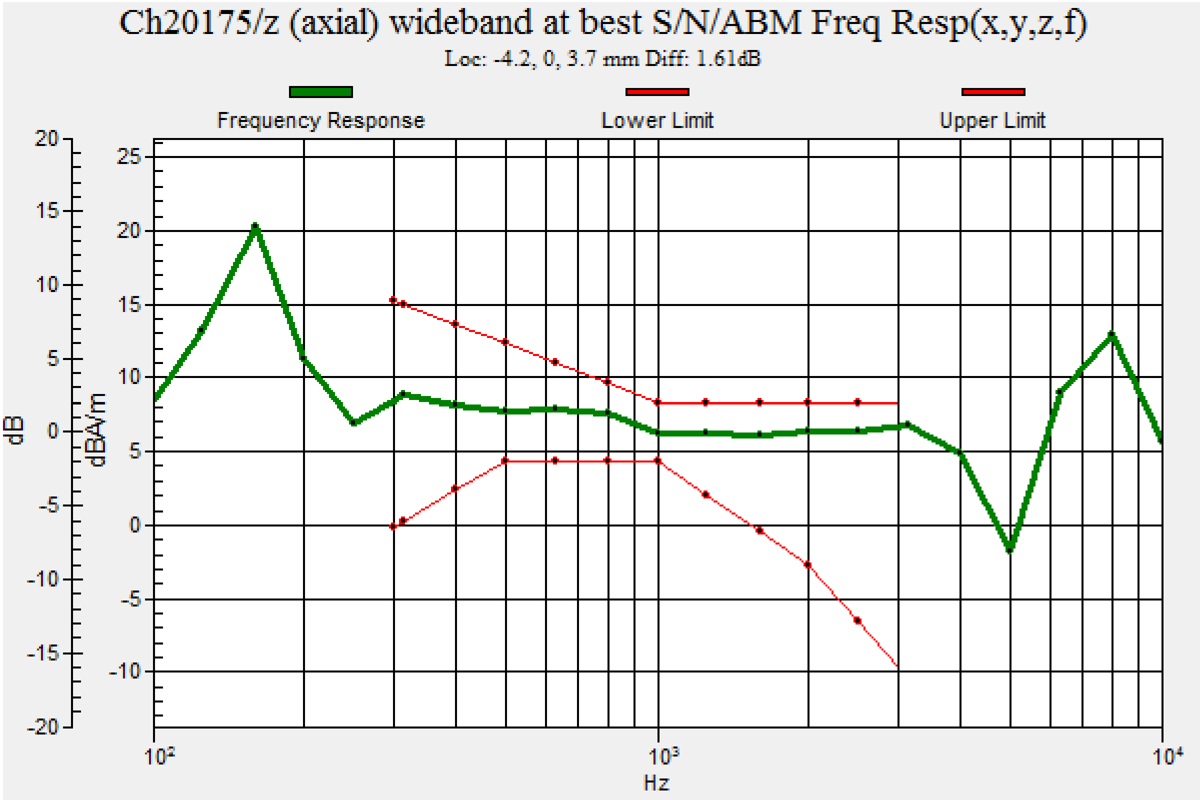
HAC_T-Coil_LTE Band 4_20M_QPSK_1RB_0offset_12.2Kbps_Ch20175_Z

Communication System: UID 10169 - CAB, LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK);
Frequency: 1732.5 MHz;Duty Cycle: 1:3.74111
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch20175/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 59.21 dB
ABM1 comp = 5.22 dBA/m
BWC Factor = 1.78 dB
Location: -4.2, 0, 3.7 mm





Ch20175/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4.2, 0, 3.7 mm Diff: 1.61dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

HAC_T-Coil_LTE Band 4_20M_QPSK_1RB_0offset_12.2Kbps_Ch20175_Y

Communication System: UID 10169 - CAB, LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK);
Frequency: 1732.5 MHz;Duty Cycle: 1:3.74111
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch20175/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 44.85 dB
ABM1 comp = -4.78 dBA/m
BWC Factor = 1.35 dB
Location: -4.2, 12.5, 3.7 mm

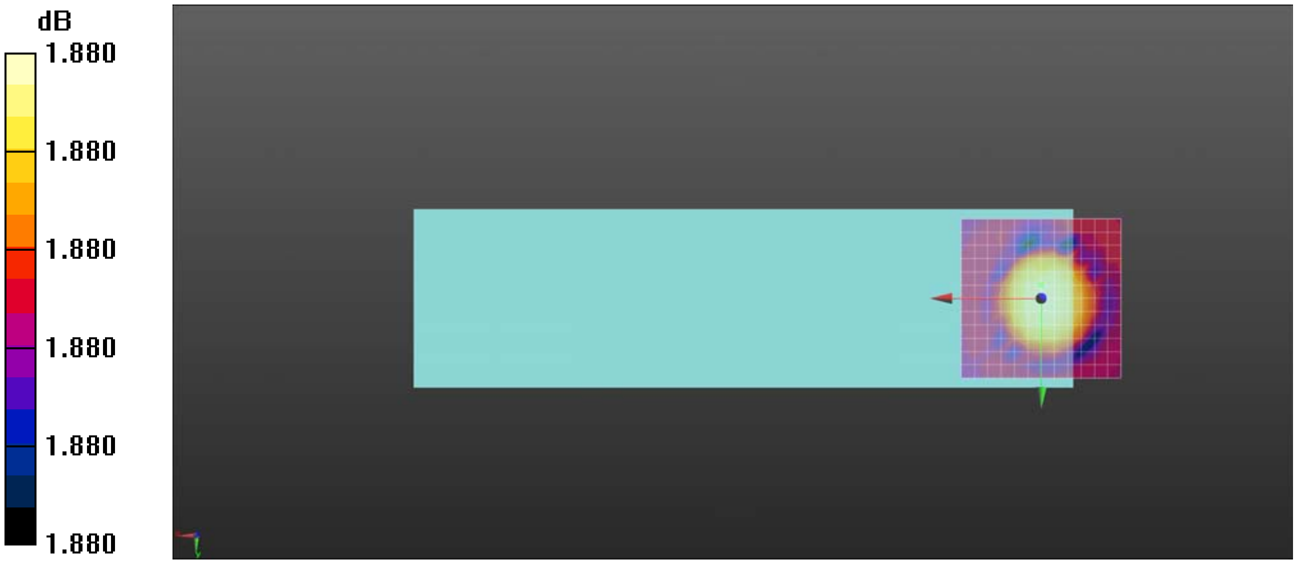
0 dB = 174.8 = 44.85 dB

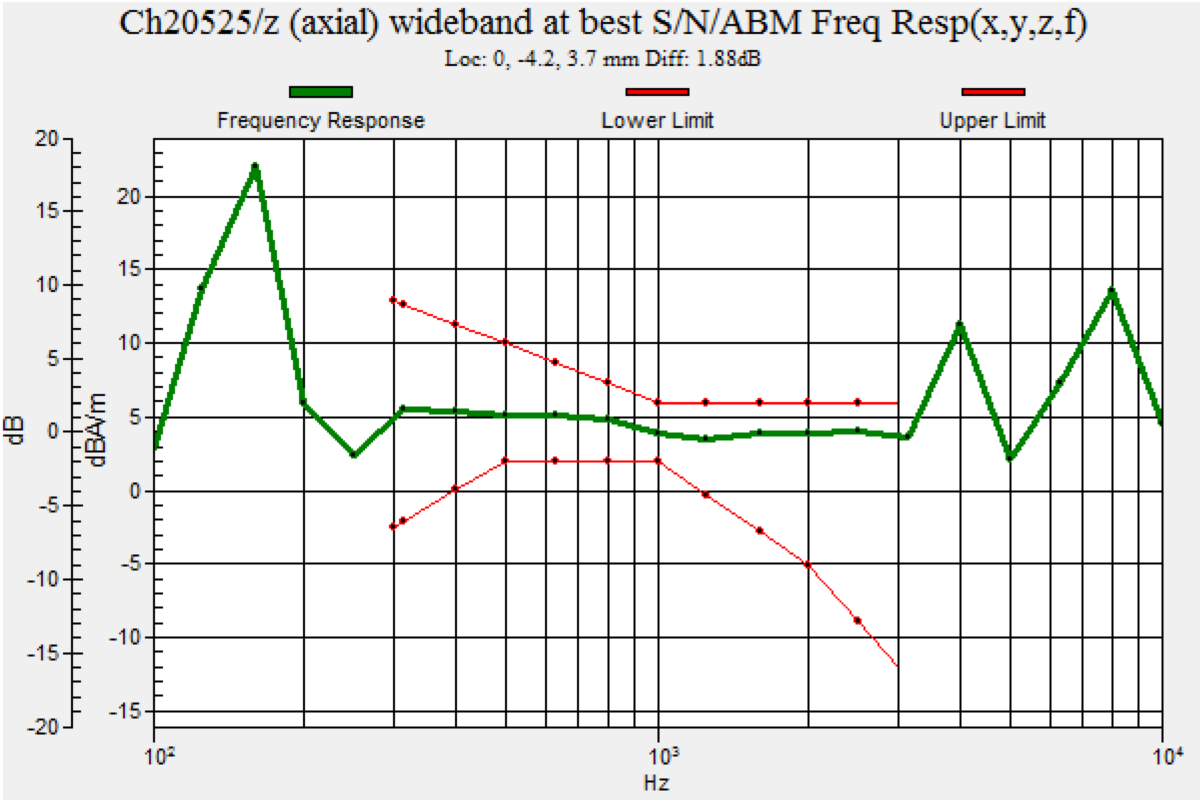
HAC_T-Coil_LTE Band 5_10M_QPSK_1RB_24offset_12.2Kbps_Ch20525_Z

Communication System: UID 10175 - CAB, LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK);
Frequency: 836.5 MHz;Duty Cycle: 1:3.7325
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch20525/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 47.82 dB
ABM1 comp = 3.45 dBA/m
BWC Factor = 0.33 dB
Location: 0, -4.2, 3.7 mm





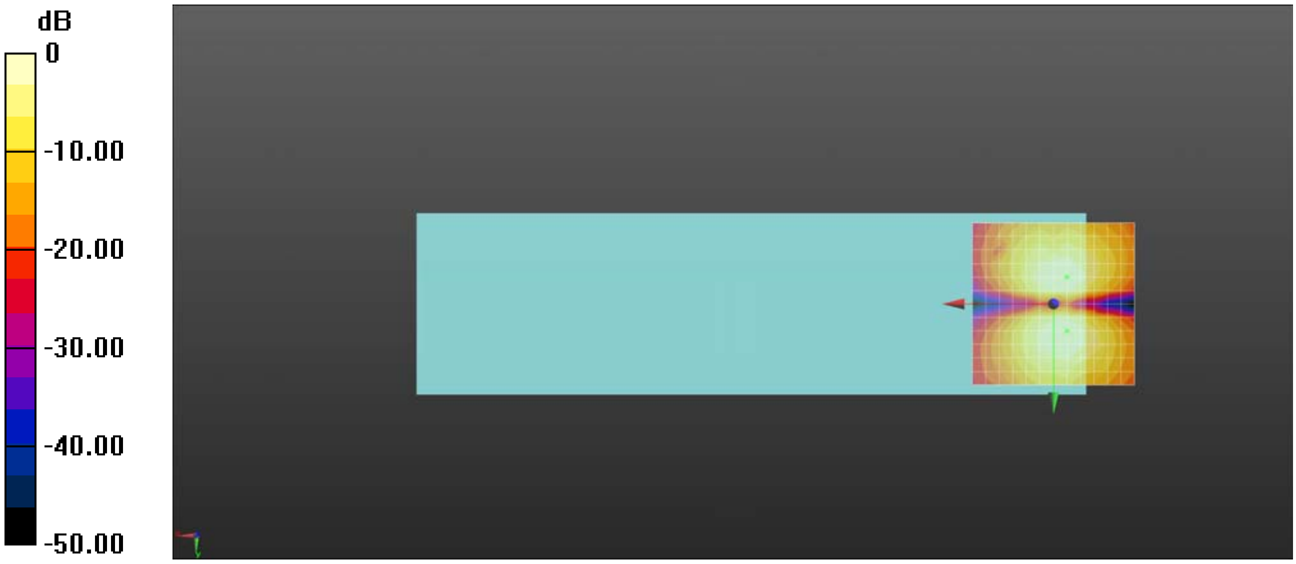
Ch20525/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: 0, -4.2, 3.7 mm Diff: 1.88dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

HAC_T-Coil_LTE Band 5_10M_QPSK_1RB_24offset_12.2Kbps_Ch20525_Y

Communication System: UID 10175 - CAB, LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK);
Frequency: 836.5 MHz;Duty Cycle: 1:3.7325
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch20525/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 45.08 dB
ABM1 comp = -6.11 dBA/m
BWC Factor = -0.08 dB
Location: -4.2, -8.3, 3.7 mm



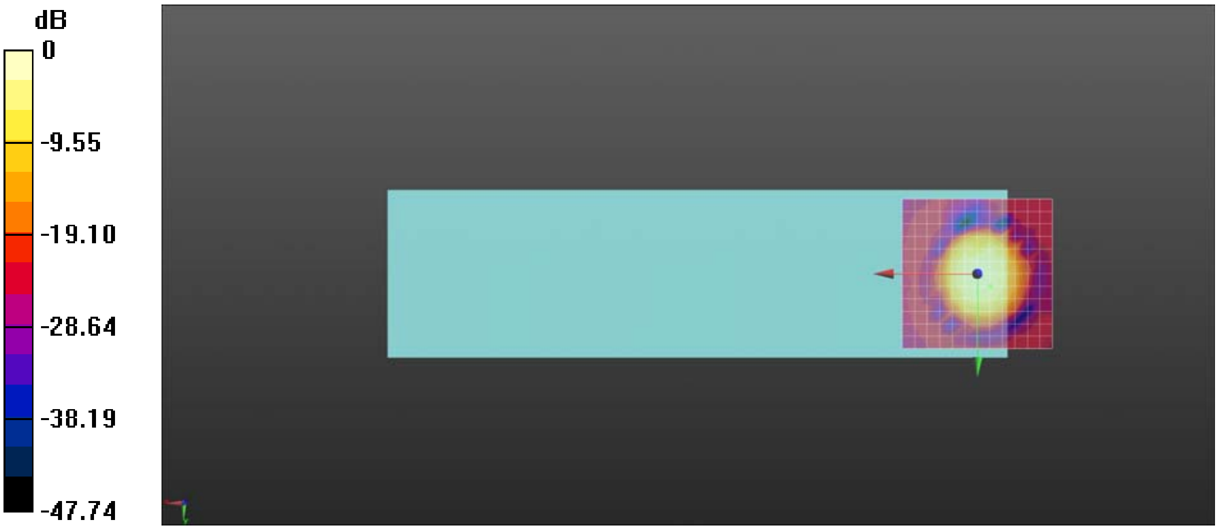
0 dB = 179.5 = 45.08 dB

HAC_T-Coil_LTE Band 12_10M_QPSK_1RB_0offset_12.2Kbps_Ch23095_Z

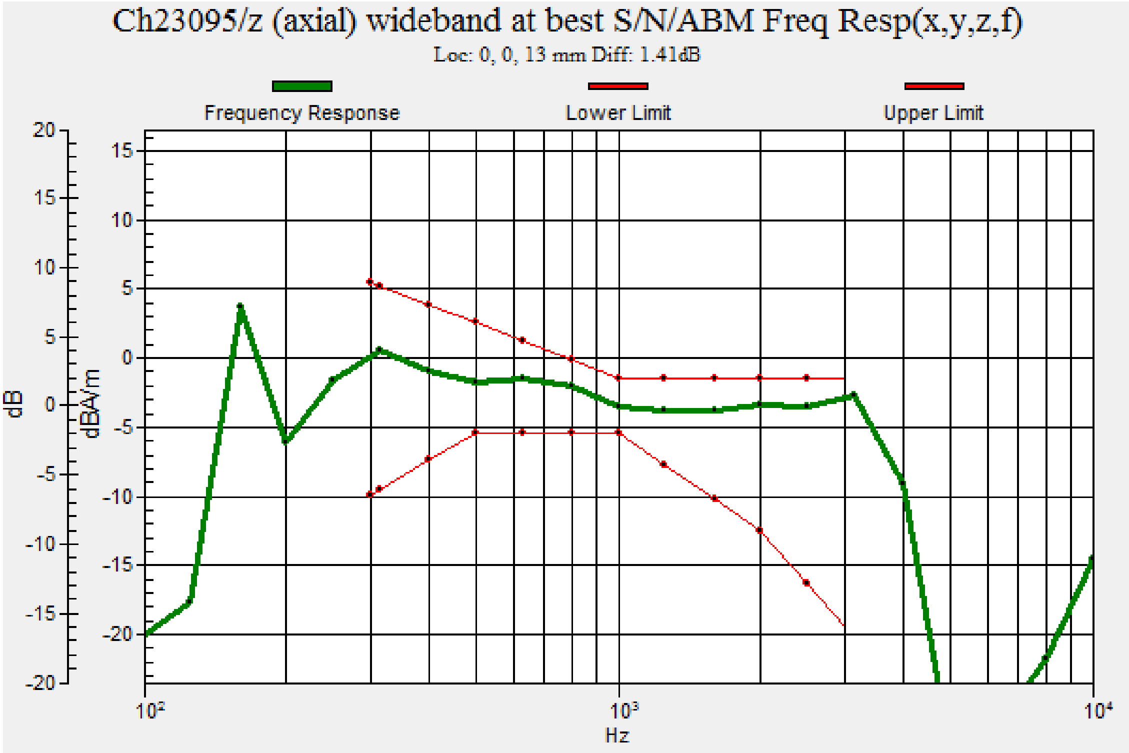
Communication System: UID 10175 - CAB, LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK); Frequency: 707.5 MHz;Duty Cycle: 1:3.7325
Medium: Air Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 0 kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch23095/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 48.48 dB
ABM1 comp = 4.00 dBA/m
BWC Factor = 1.25 dB
Location: -4.2, 4.2, 3.7 mm



0 dB = 265.4 = 48.48 dB


Ch23095/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: 0, 0, 13 mm Diff: 1.41dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz
10^2
10^3
10^4

HAC_T-Coil_LTE Band 12_10M_QPSK_1RB_0offset_12.2Kbps_Ch23095_Y

Communication System: UID 10175 - CAB, LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK);
Frequency: 707.5 MHz;Duty Cycle: 1:3.7325
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch23095/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 44.80 dB
ABM1 comp = -4.97 dBA/m
BWC Factor = 1.25 dB
Location: 0, -8.3, 3.7 mm

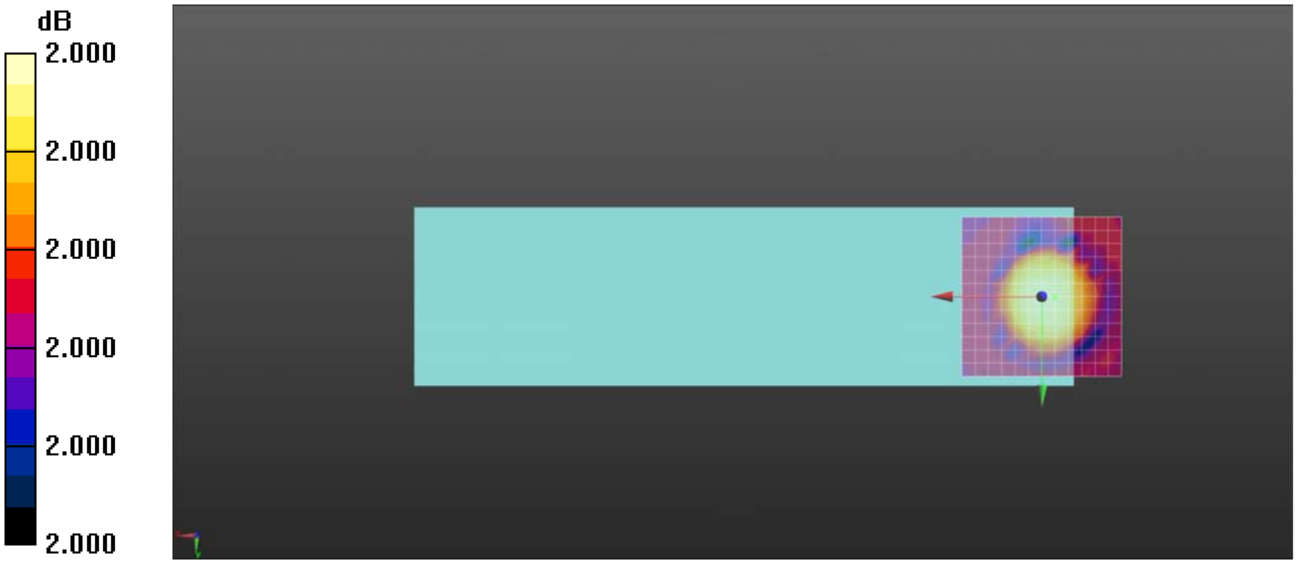
0 dB = 173.9 = 44.81 dB

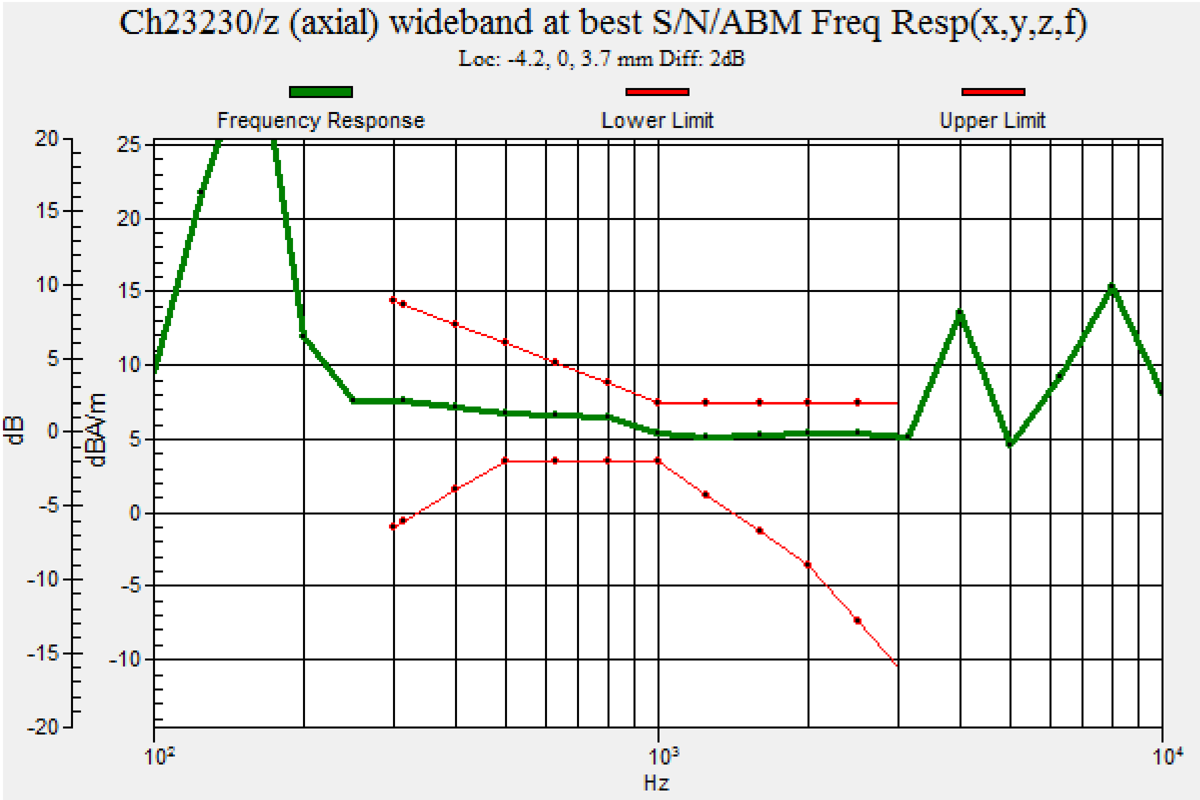
HAC_T-Coil_LTE Band 13_10M_QPSK_1RB_0offset_12.2Kbps_Ch23230_Z

Communication System: UID 10175 - CAB, LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK);
Frequency: 782 MHz;Duty Cycle: 1:3.7325
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch23230/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f) (1x1x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 48.43 dB
ABM1 comp = 4.34 dBA/m
BWC Factor = 0.99 dB
Location: -4.2, 0, 3.7 mm



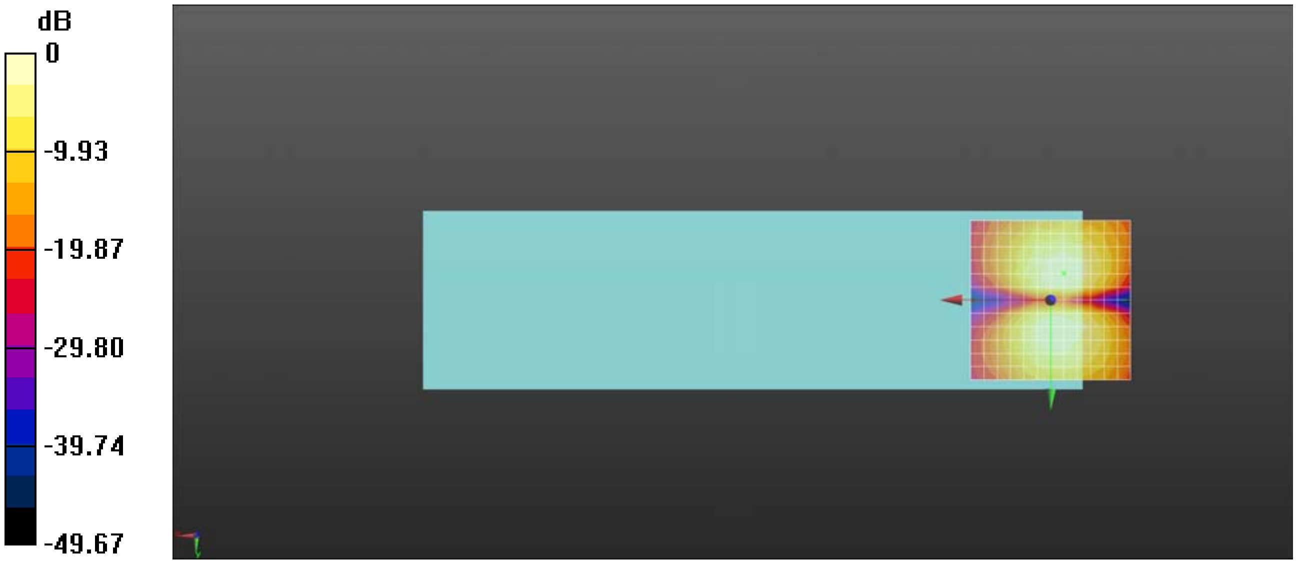

Ch23230/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4.2, 0, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz
10^2
10^3
10^4

HAC_T-Coil_LTE Band 13_10M_QPSK_1RB_0offset_12.2Kbps_Ch23230_Y

Communication System: UID 10175 - CAB, LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK);
Frequency: 782 MHz;Duty Cycle: 1:3.7325
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch23230/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 45.54 dB
ABM1 comp = -5.07 dBA/m
BWC Factor = 0.99 dB
Location: -4.2, -8.3, 3.7 mm



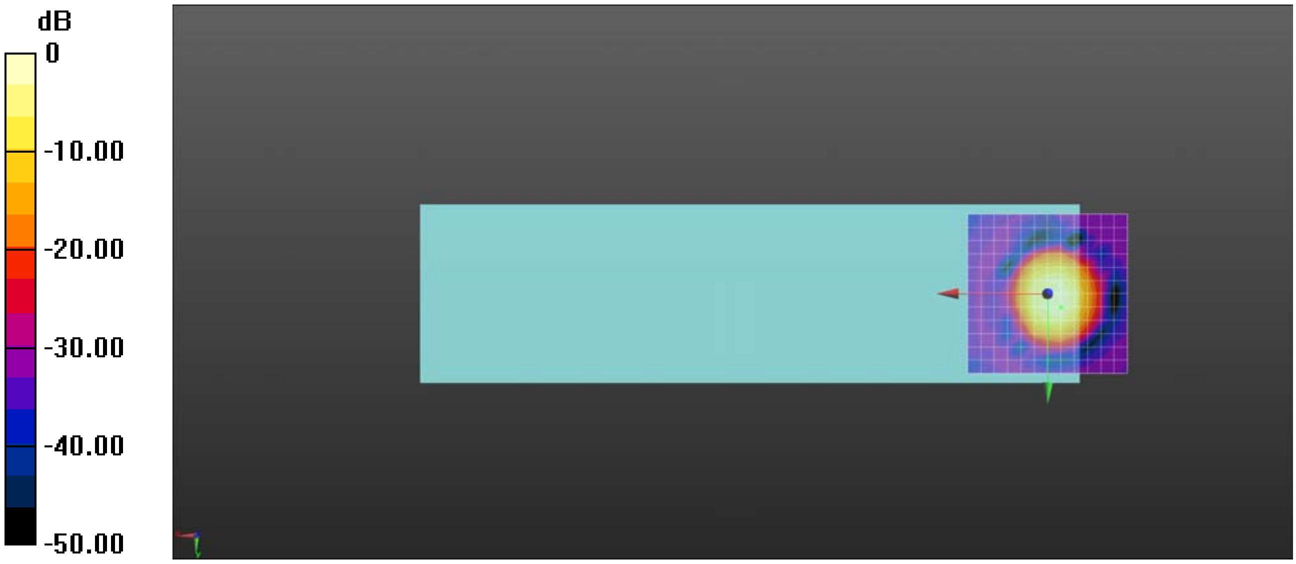
0 dB = 189.3 = 45.54 dB

HAC_T-Coil_LTE Band 25_20M_QPSK_1RB_0offset_12.2Kbps_Ch26365_Z

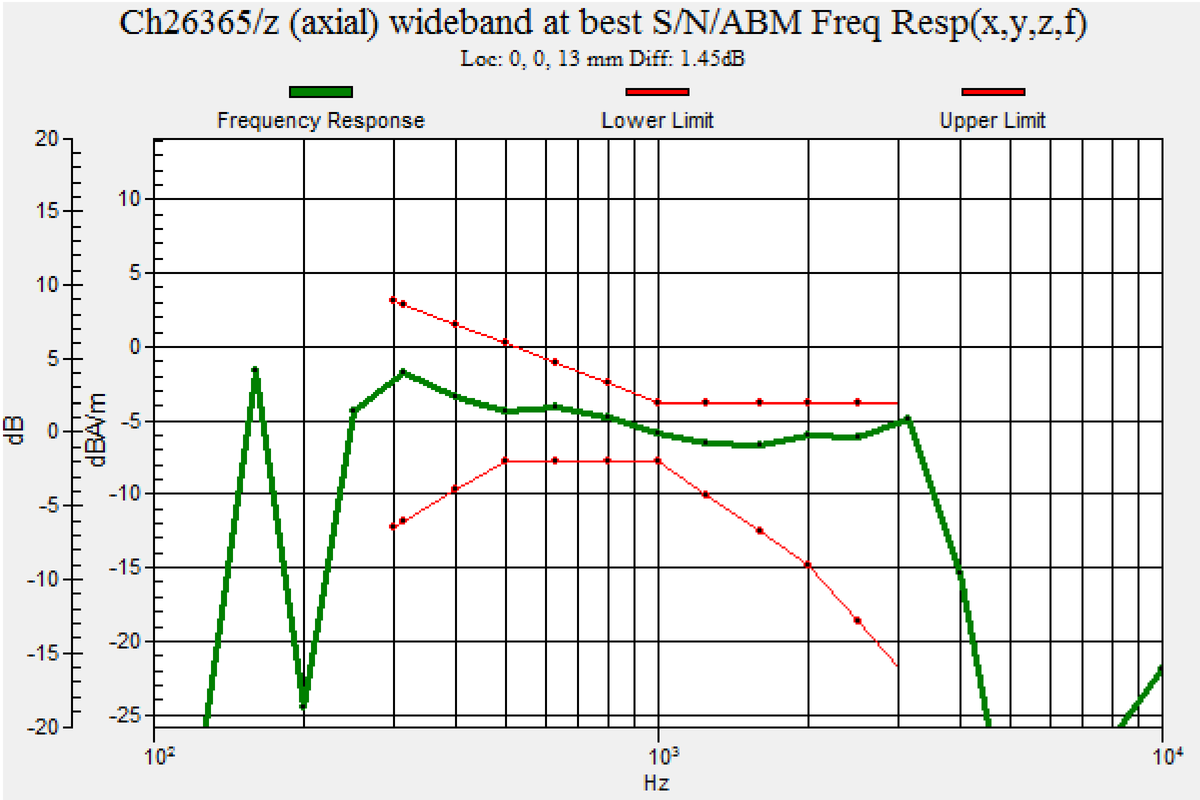
Communication System: UID 10169 - CAB, LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK);
Frequency: 1882.5 MHz;Duty Cycle: 1:3.74111
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch26365/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 58.53 dB
ABM1 comp = 4.43 dBA/m
BWC Factor = 0.55 dB
Location: -4.2, 4.2, 3.7 mm



0 dB = 844.3 = 58.53 dB



Ch26365/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: 0, 0, 13 mm Diff: 1.45dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

HAC_T-Coil_LTE Band 25_20M_QPSK_1RB_0offset_12.2Kbps_Ch26365_Y

Communication System: UID 10169 - CAB, LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK);
Frequency: 1882.5 MHz;Duty Cycle: 1:3.74111
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV2 - 1048; ; Calibrated: 2018.10.24
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn480; Calibrated: 2019.04.11
- 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)

Ch26365/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
ABM1/ABM2 = 44.89 dB
ABM1 comp = -4.42 dBA/m
BWC Factor = 1.65 dB
Location: -4.2, 12.5, 3.7 mm

0 dB = 175.5 = 44.89 dB

Annex D DASY Calibration Certificate

In Collaboration with
s p e a g
CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Client : **Morlab** **Certificate No: Z18-60439**

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 480
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	October 29, 2018

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	20-Jun-18 (CTTL, No.J18X05034)	June-19

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	林浩
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: October 31, 2018

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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 report provide only calibration results for DAE, it does not contain other performance test results.

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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	404.705 ± 0.15% (k=2)	404.145 ± 0.15% (k=2)	404.485 ± 0.15% (k=2)
Low Range	3.92814 ± 0.7% (k=2)	3.94985 ± 0.7% (k=2)	3.93739 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	222° ± 1 °

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 **Morlab-SZ (Auden)**

Certificate No: AM1DV2-1048_Oct18

CALIBRATION CERTIFICATE

Object	AM1DV2 - SN: 1048
Calibration procedure(s)	QA CAL-24.v4 Calibration procedure for AM1D magnetic field probes and TMFS in the audio range
Calibration date:	October 24, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	03-Sep-18 (No. 23488)	Sep-19
Reference Probe AM1DV2	SN: 1008	03-Jan-18 (No. AM1DV2-1008_Jan18)	Jan-19
DAE4	SN: 781	17-Jan-18 (No. DAE4-781_Jan18)	Jan-19

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	Leif Klysner
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 25, 2018

[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	**AM1DV2** Audio Magnetic 1D Field Probe
Type No	SP AM1 001 AF
Serial No	**1048**

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

Manufacturer / Origin	Schmid & Partner Engineering AG, Zurich, Switzerland

Calibration data

Connector rotation angle	(in DASY system)	**63.8** °	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	**4.06** °	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	**0.0630 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%.