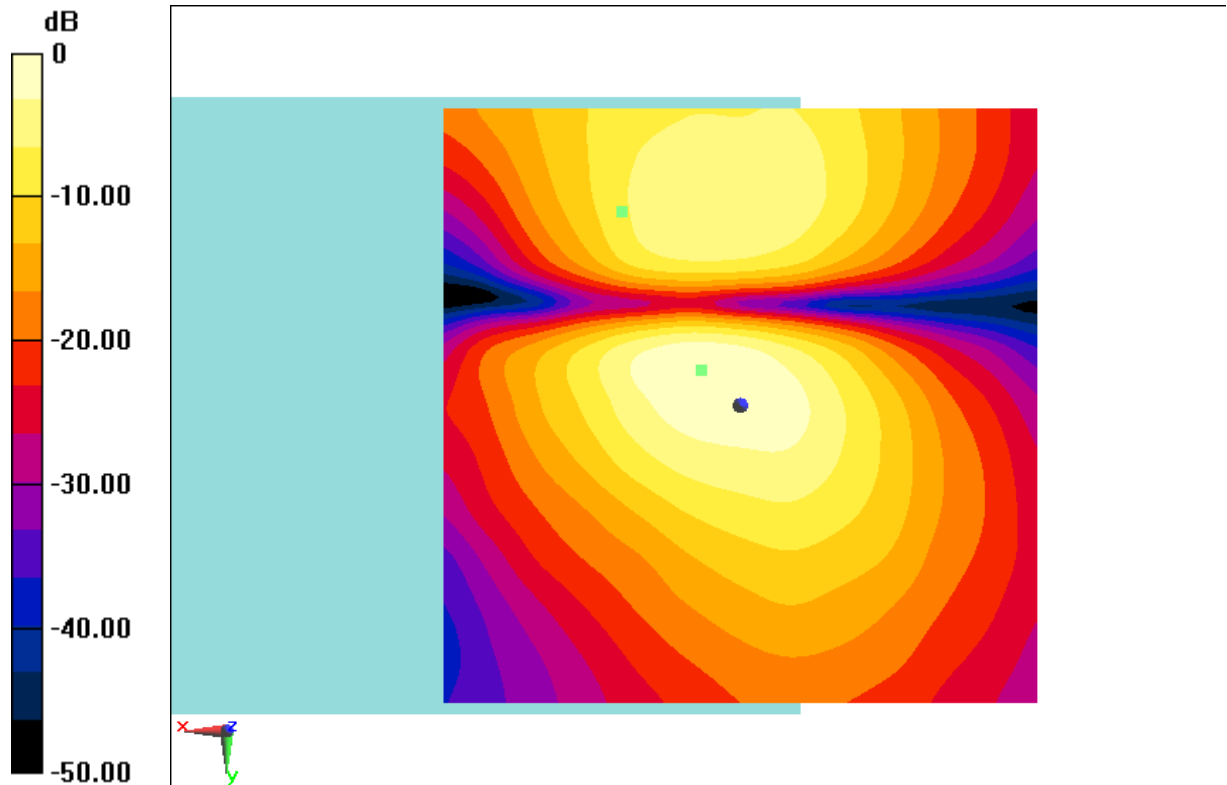


BWC Factor = 0.16 dB

Location: 3.3, -2.9, 3.7 mm



0 dB = 0.4534 A/m = -6.87 dBA/m

**Fig B.11 T-Coil LTE B2**



**T-Coil LTE B2 20M Perpendicular**

Date: 2018-5-31

Electronics: DAE4 Sn777

Medium: Air

Medium parameters used:  $\sigma = 0$  mho/m,  $\epsilon_r = 1$ ;  $\rho = 1$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C

Communication System: LTE B2; Frequency: 1880 MHz; Duty Cycle: 1:1

Probe: AM1DV2 - 1064;

T-Coil/General Scans 50-H 16QAM EVS-NB-5.9/z (axial) 4.2mm 50 x 50

20M/ABM Interpolated Signal(x, y, z) (121x121x1): Interpolated grid:

dx=1.000 mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1 = 1.97 dBA/m

BWC Factor = 0.16 dB

Location: 10, -8.8, 3.7 mm

T-Coil/General Scans 50-H 16QAM EVS-NB-5.9/z (axial) 4.2mm 50 x 50

20M/ABM Interpolated SNR(x, y, z) (121x121x1): Interpolated grid: dx=1.000

mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

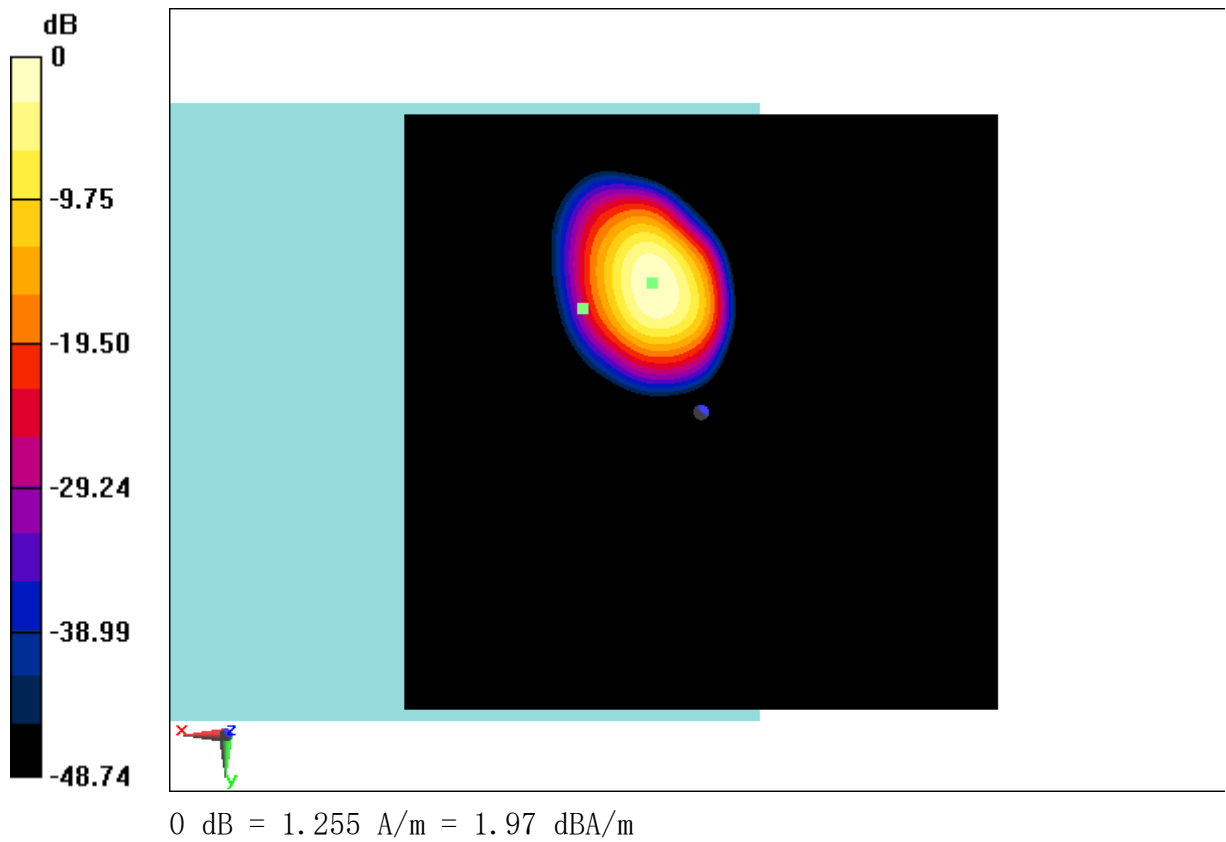
BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 33.71 dB

ABM1 comp = -4.00 dBA/m  
BWC Factor = 0.16 dB  
Location: 4.2, -10.8, 3.7 mm



**Fig B.12 T-Coil LTE B2**



**T-Coil LTE B5 5M Transverse**

Date: 2018-5-30

Electronics: DAE4 Sn777

Medium: Air

Medium parameters used:  $\sigma = 0$  mho/m,  $\epsilon_r = 1$ ;  $\rho = 1$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C

Communication System: LTE B5; Frequency: 836.5 MHz; Duty Cycle: 1:1

Probe: AM1DV2 - 1064;

**T-Coil/General Scans/y (transversal) 4.2mm 50 x 50 5M/ABM Interpolated**

**Signal(x, y, z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1 = -2.62 dBA/m

BWC Factor = 0.16 dB

Location: 11.3, -15.4, 3.7 mm

**T-Coil/General Scans/y (transversal) 4.2mm 50 x 50 5M/ABM Interpolated**

**SNR(x, y, z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

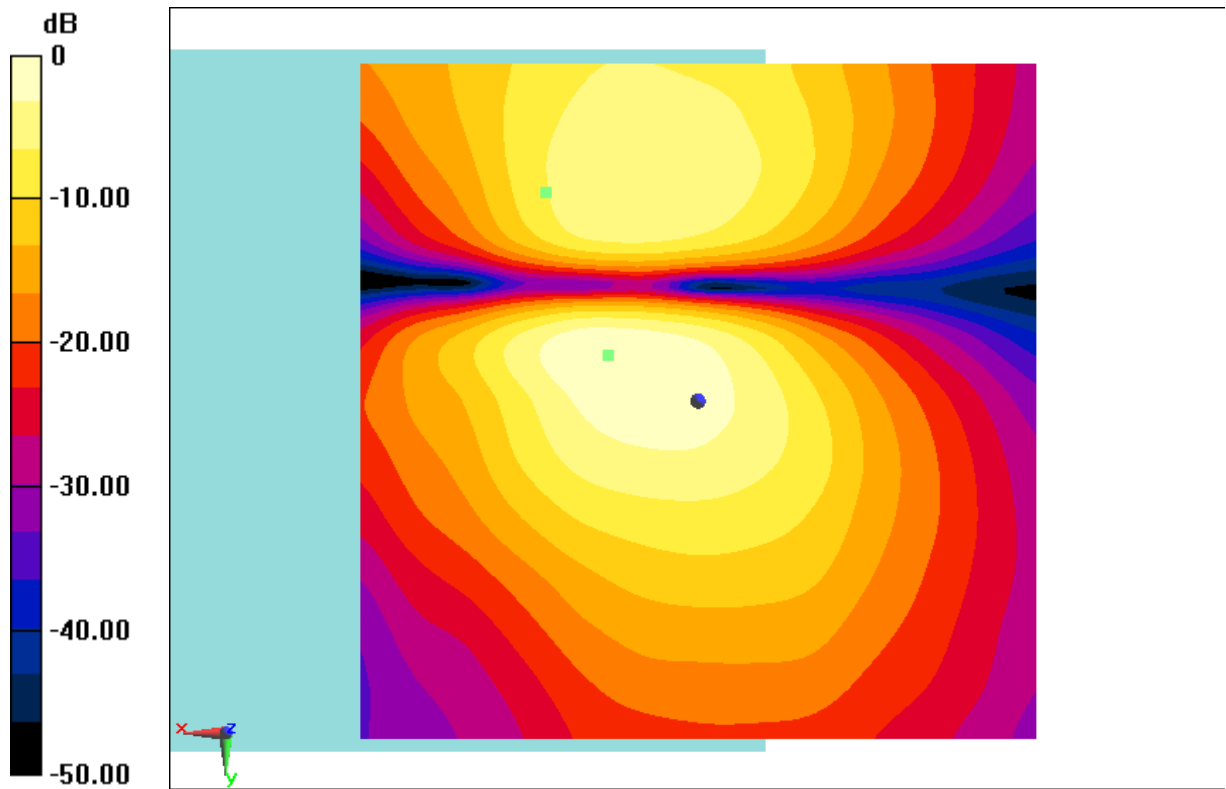
**Cursor:**

ABM1/ABM2 = 34.70 dB

ABM1 comp = -5.01 dBA/m

BWC Factor = 0.16 dB

Location: 6.7, -3.3, 3.7 mm



0 dB = 0.7399 A/m = -2.62 dBA/m

**Fig B.13 T-Coil LTE B5**



**T-Coil LTE B5 10M Perpendicular**

Date: 2018-5-30

Electronics: DAE4 Sn777

Medium: Air

Medium parameters used:  $\sigma = 0$  mho/m,  $\epsilon_r = 1$ ;  $\rho = 1$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C

Communication System: LTE B5; Frequency: 836.5 MHz; Duty Cycle: 1:1

Probe: AM1DV2 - 1064;

**T-Coil/General Scans/z (axial) 4.2mm 50 x 50 10M/ABM Interpolated**

**Signal(x, y, z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1 = 5.84 dBA/m

BWC Factor = 0.16 dB

Location: 11.7, -8.8, 3.7 mm

**T-Coil/General Scans/z (axial) 4.2mm 50 x 50 10M/ABM Interpolated**

**SNR(x, y, z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

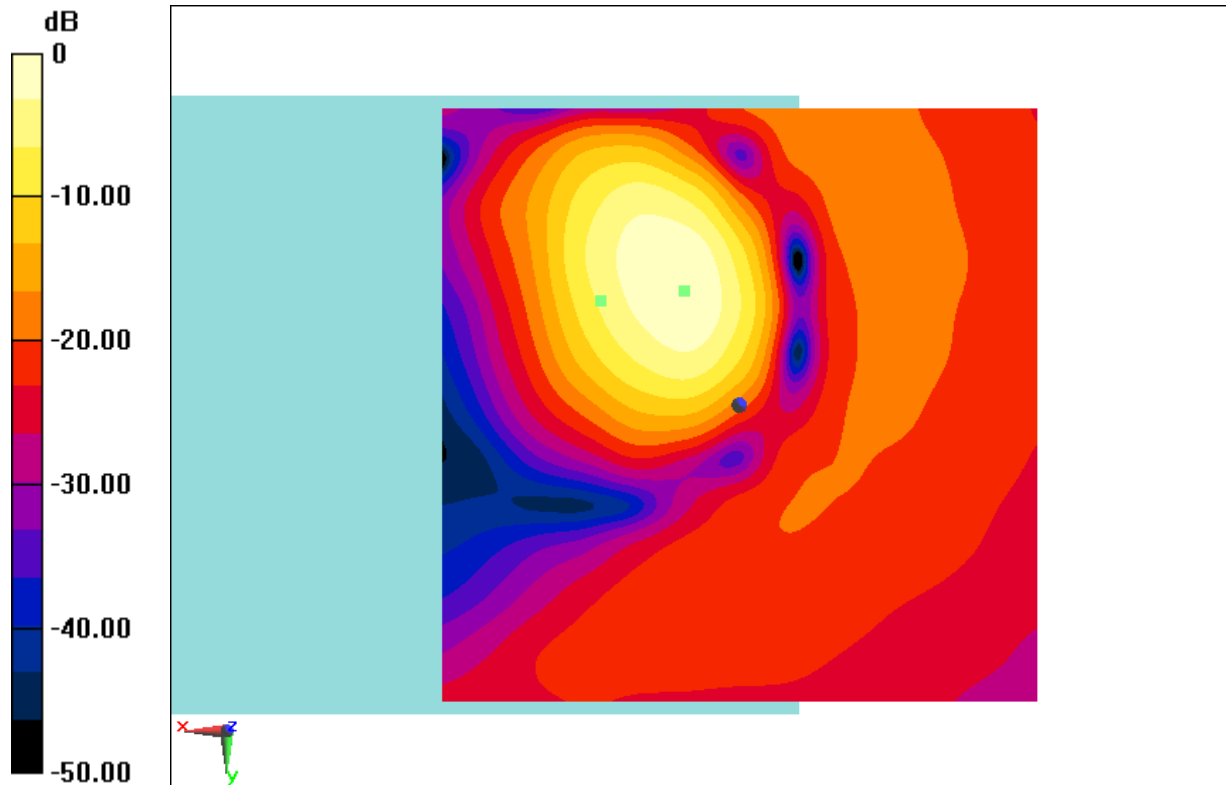
**Cursor:**

ABM1/ABM2 = 38.83 dB

ABM1 comp = -1.64 dBA/m

BWC Factor = 0.16 dB

Location: 4.6, -9.6, 3.7 mm



0 dB = 1.958 A/m = 5.84 dBA/m

**Fig B.14 T-Coil LTE B5**



**T-Coil LTE B12 10M Transverse**

Date: 2018-5-30

Electronics: DAE4 Sn777

Medium: Air

Medium parameters used:  $\sigma = 0$  mho/m,  $\epsilon_r = 1$ ;  $\rho = 1$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C

Communication System: LTE B12; Frequency: 707.5 MHz; Duty Cycle: 1:1

Probe: AM1DV2 - 1064;

T-Coil/General Scans/y (transversal) 4.2mm 50 x 50 10M/ABM

Interpolated Signal (x, y, z) (121x121x1): Interpolated grid: dx=1.000 mm,

dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1 = -2.87 dBA/m

BWC Factor = 0.16 dB

Location: 11.7, -16.3, 3.7 mm

T-Coil/General Scans/y (transversal) 4.2mm 50 x 50 10M/ABM

Interpolated SNR (x, y, z) (121x121x1): Interpolated grid: dx=1.000 mm,

dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

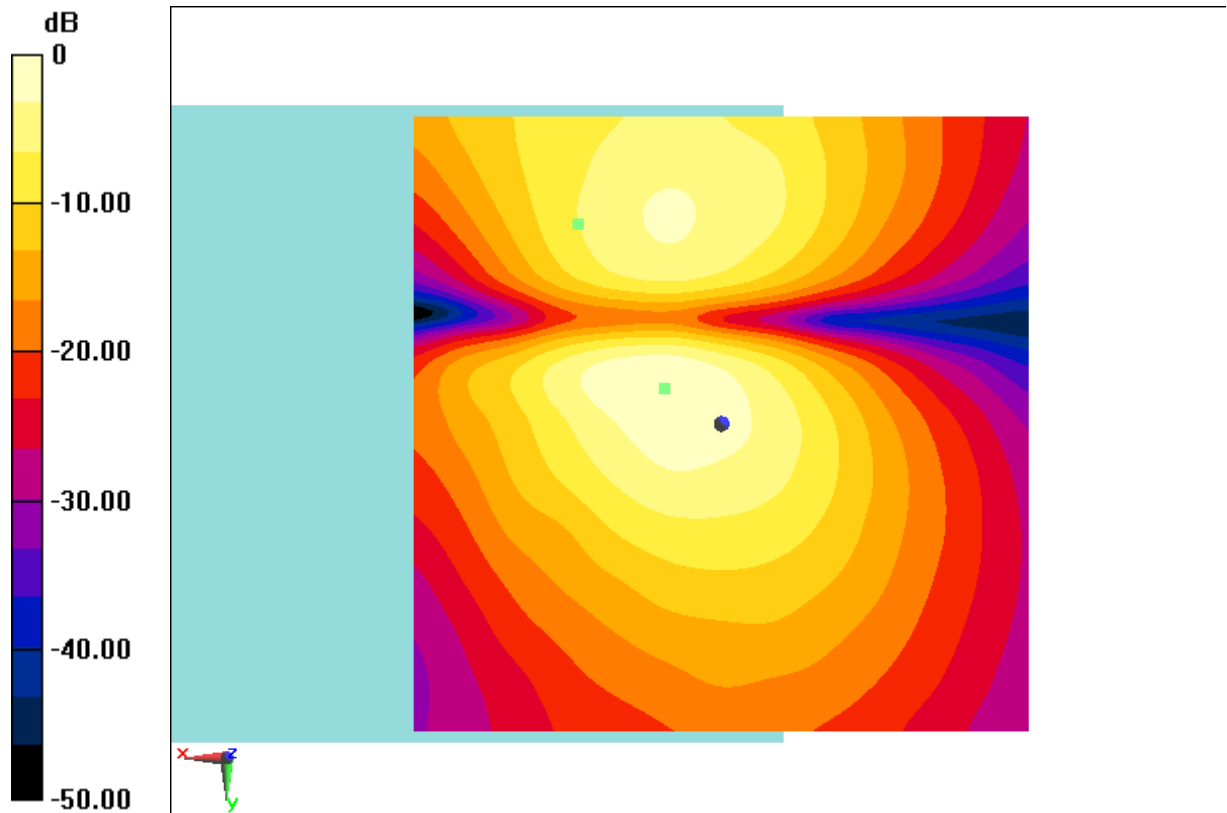
ABM1/ABM2 = 34.79 dB

ABM1 comp = -7.33 dBA/m



BWC Factor = 0.16 dB

Location: 4.6, -2.9, 3.7 mm



0 dB = 0.7188 A/m = -2.87 dBA/m

**Fig B.15 T-Coil LTE B12**



**T-Coil LTE B12 10M Perpendicular**

Date: 2018-5-30

Electronics: DAE4 Sn777

Medium: Air

Medium parameters used:  $\sigma = 0$  mho/m,  $\epsilon_r = 1$ ;  $\rho = 1$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C

Communication System: LTE B12; Frequency: 707.5 MHz; Duty Cycle: 1:1

Probe: AM1DV2 - 1064;

**T-Coil/General Scans/z (axial) 4.2mm 50 x 50 10M/ABM Interpolated**

**Signal(x, y, z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1 = 5.68 dBA/m

BWC Factor = 0.16 dB

Location: 10.4, -9.2, 3.7 mm

**T-Coil/General Scans/z (axial) 4.2mm 50 x 50 10M/ABM Interpolated**

**SNR(x, y, z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

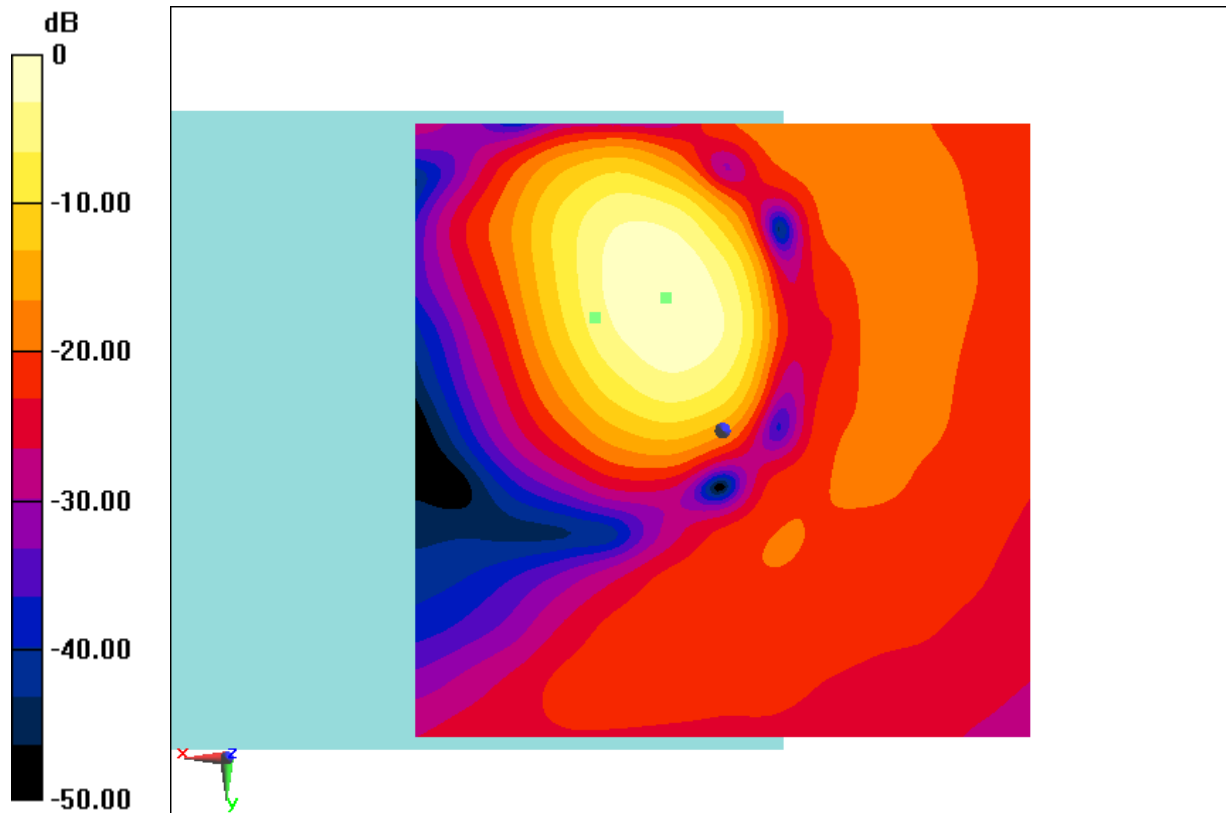
**Cursor:**

ABM1/ABM2 = 37.97 dB

ABM1 comp = 0.12 dBA/m

BWC Factor = 0.16 dB

Location: 4.6, -10.8, 3.7 mm



0 dB = 1.922 A/m = 5.68 dBA/m

**Fig B.16 T-Coil LTE B12**



**T-Coil LTE B13 10M Transverse**

Date: 2018-5-30

Electronics: DAE4 Sn777

Medium: Air

Medium parameters used:  $\sigma = 0$  mho/m,  $\epsilon_r = 1$ ;  $\rho = 1$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C

Communication System: LTE B13; Frequency: 782 MHz; Duty Cycle: 1:1

Probe: AM1DV2 - 1064;

T-Coil/General Scans/y (transversal) 4.2mm 50 x 50 10M/ABM

Interpolated Signal (x, y, z) (121x121x1): Interpolated grid: dx=1.000 mm,

dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1 = -2.85 dBA/m

BWC Factor = 0.16 dB

Location: 11.3, -16.7, 3.7 mm

T-Coil/General Scans/y (transversal) 4.2mm 50 x 50 10M/ABM

Interpolated SNR (x, y, z) (121x121x1): Interpolated grid: dx=1.000 mm,

dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

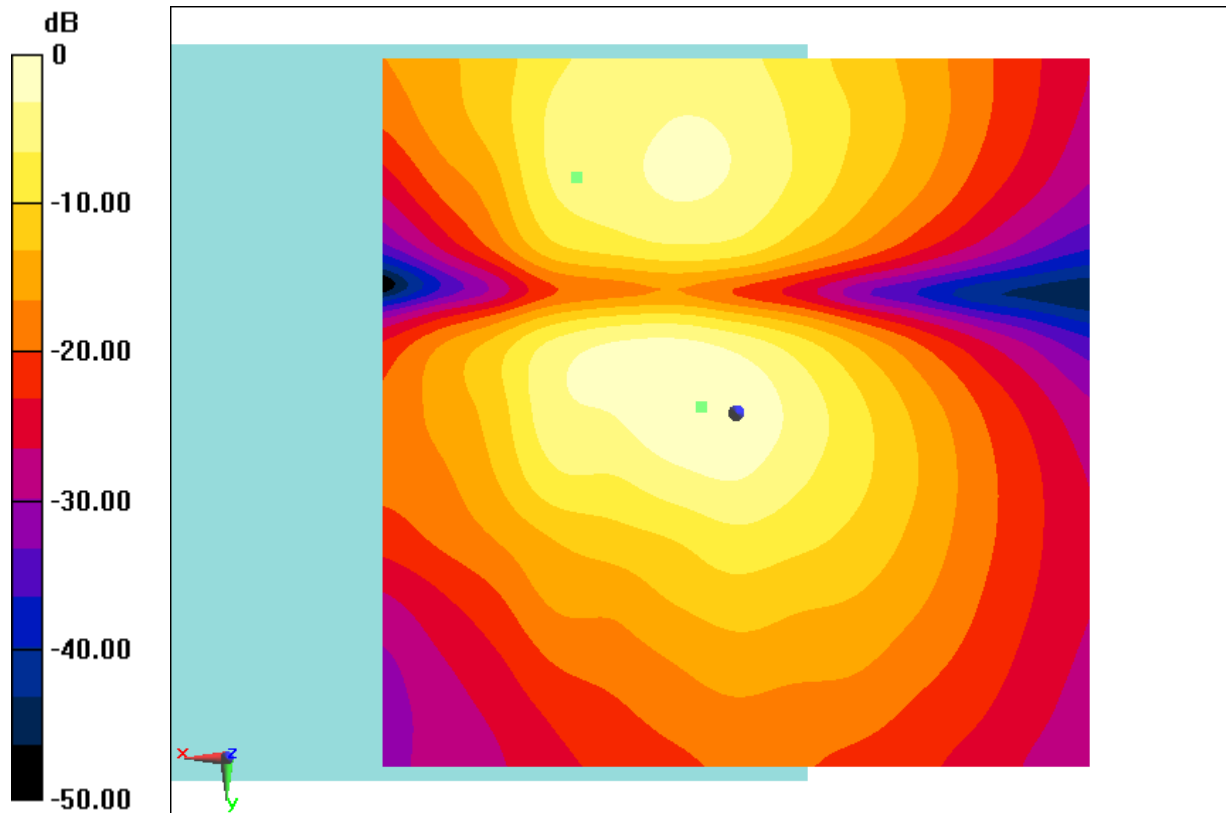
**Cursor:**

ABM1/ABM2 = 35.76 dB

ABM1 comp = -8.75 dBA/m

BWC Factor = 0.16 dB

Location: 2.5, -0.4, 3.7 mm



0 dB = 0.7200 A/m = -2.85 dBA/m

**Fig B.17 T-Coil LTE B13**



**T-Coil LTE B13 10M Perpendicular**

Date: 2018-5-30

Electronics: DAE4 Sn777

Medium: Air

Medium parameters used:  $\sigma = 0$  mho/m,  $\epsilon_r = 1$ ;  $\rho = 1$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C

Communication System: LTE B13; Frequency: 782 MHz; Duty Cycle: 1:1

Probe: AM1DV2 - 1064;

**T-Coil/General Scans/z (axial) 4.2mm 50 x 50 5M/ABM Interpolated**

**Signal(x, y, z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1 = 5.45 dBA/m

BWC Factor = 0.16 dB

Location: 11.7, -10.8, 3.7 mm

**T-Coil/General Scans/z (axial) 4.2mm 50 x 50 5M/ABM Interpolated**

**SNR(x, y, z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

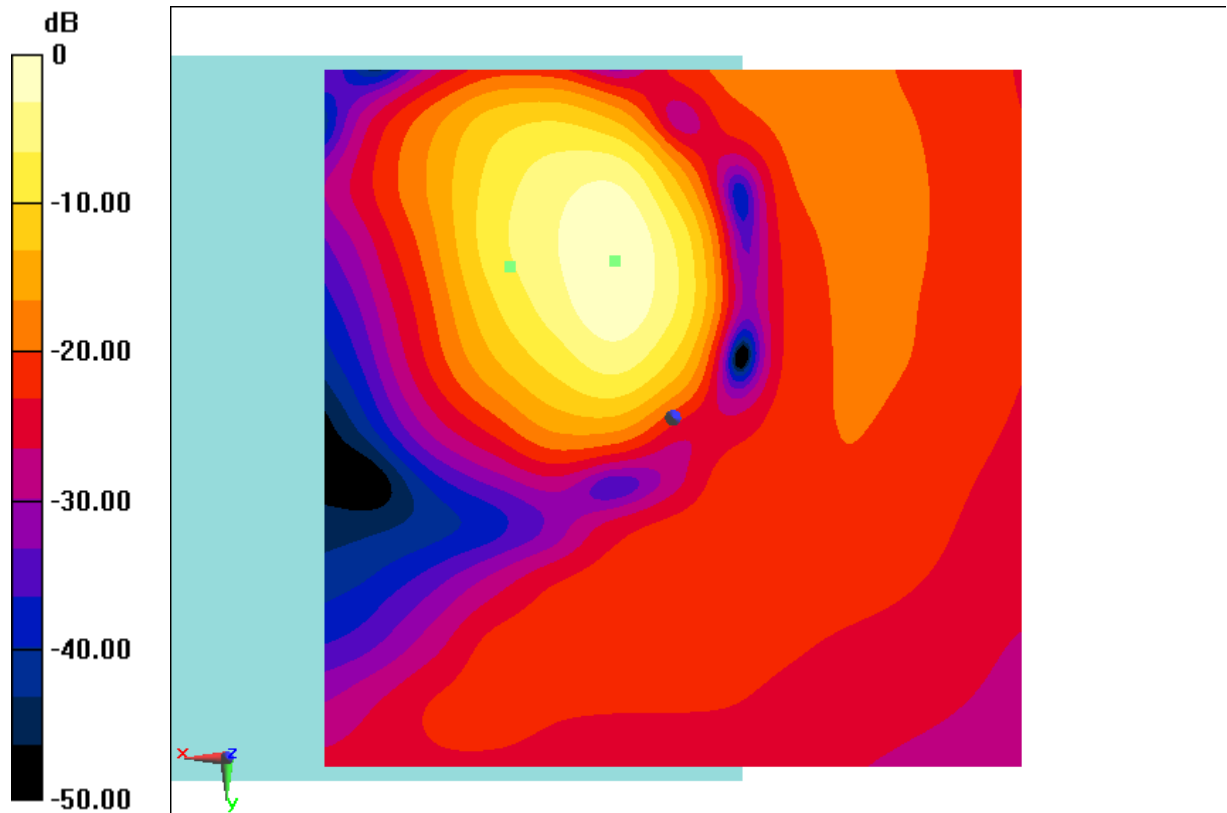
**Cursor:**

ABM1/ABM2 = 38.38 dB

ABM1 comp = -2.47 dBA/m

BWC Factor = 0.16 dB

Location: 4.2, -11.3, 3.7 mm



0 dB = 1.872 A/m = 5.45 dBA/m

**Fig B.18 T-Coil LTE B13**



**T-Coil LTE B66 15M Transverse**

Date: 2018-5-31

Electronics: DAE4 Sn777

Medium: Air

Medium parameters used:  $\sigma = 0$  mho/m,  $\epsilon_r = 1$ ;  $\rho = 1$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C

Communication System: LTE B66; Frequency: 1745 MHz; Duty Cycle: 1:1

Probe: AM1DV2 - 1064;

T-Coil/General Scans/y (transversal) 4.2mm 50 x 50 15M/ABM

Interpolated Signal (x, y, z) (121x121x1): Interpolated grid: dx=1.000 mm,

dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1 = -2.74 dBA/m

BWC Factor = 0.16 dB

Location: 12.5, -15.4, 3.7 mm

T-Coil/General Scans/y (transversal) 4.2mm 50 x 50 15M/ABM

Interpolated SNR (x, y, z) (121x121x1): Interpolated grid: dx=1.000 mm,

dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

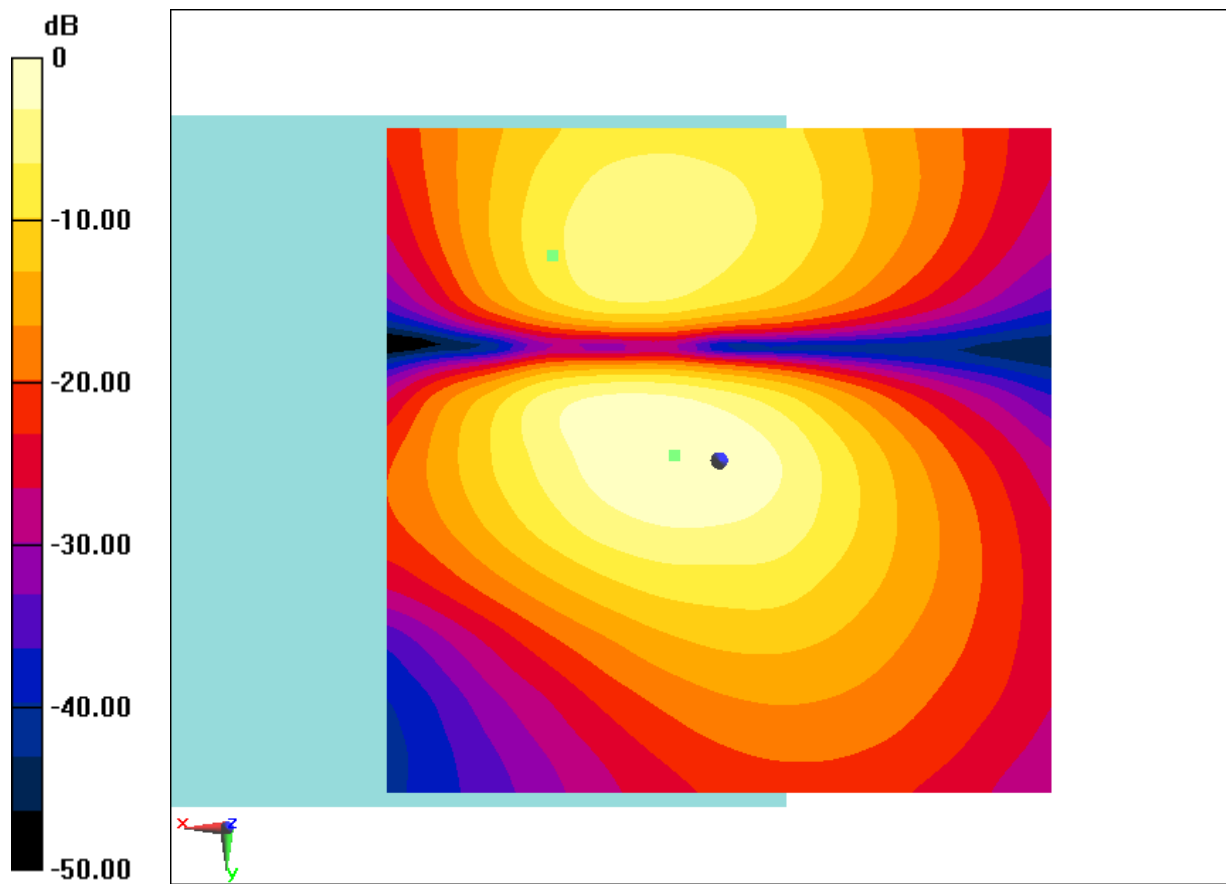
**Cursor:**

ABM1/ABM2 = 32.77 dB

ABM1 comp = -9.42 dBA/m



BWC Factor = 0.16 dB  
Location: 3.3, -0.4, 3.7 mm



0 dB = 0.7293 A/m = -2.74 dBA/m

**Fig B.19 T-Coil LTE B66**



**T-Coil LTE B66 20M Perpendicular**

Date: 2018-5-31

Electronics: DAE4 Sn777

Medium: Air

Medium parameters used:  $\sigma = 0$  mho/m,  $\epsilon_r = 1$ ;  $\rho = 1$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C

Communication System: LTE B66; Frequency: 1745 MHz; Duty Cycle: 1:1

Probe: AM1DV2 - 1064;

**T-Coil/General Scans/z (axial) 4.2mm 50 x 50 20M/ABM Interpolated**

**Signal(x, y, z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1 = 5.55 dBA/m

BWC Factor = 0.16 dB

Location: 12.1, -9.6, 3.7 mm

**T-Coil/General Scans/z (axial) 4.2mm 50 x 50 20M/ABM Interpolated**

**SNR(x, y, z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

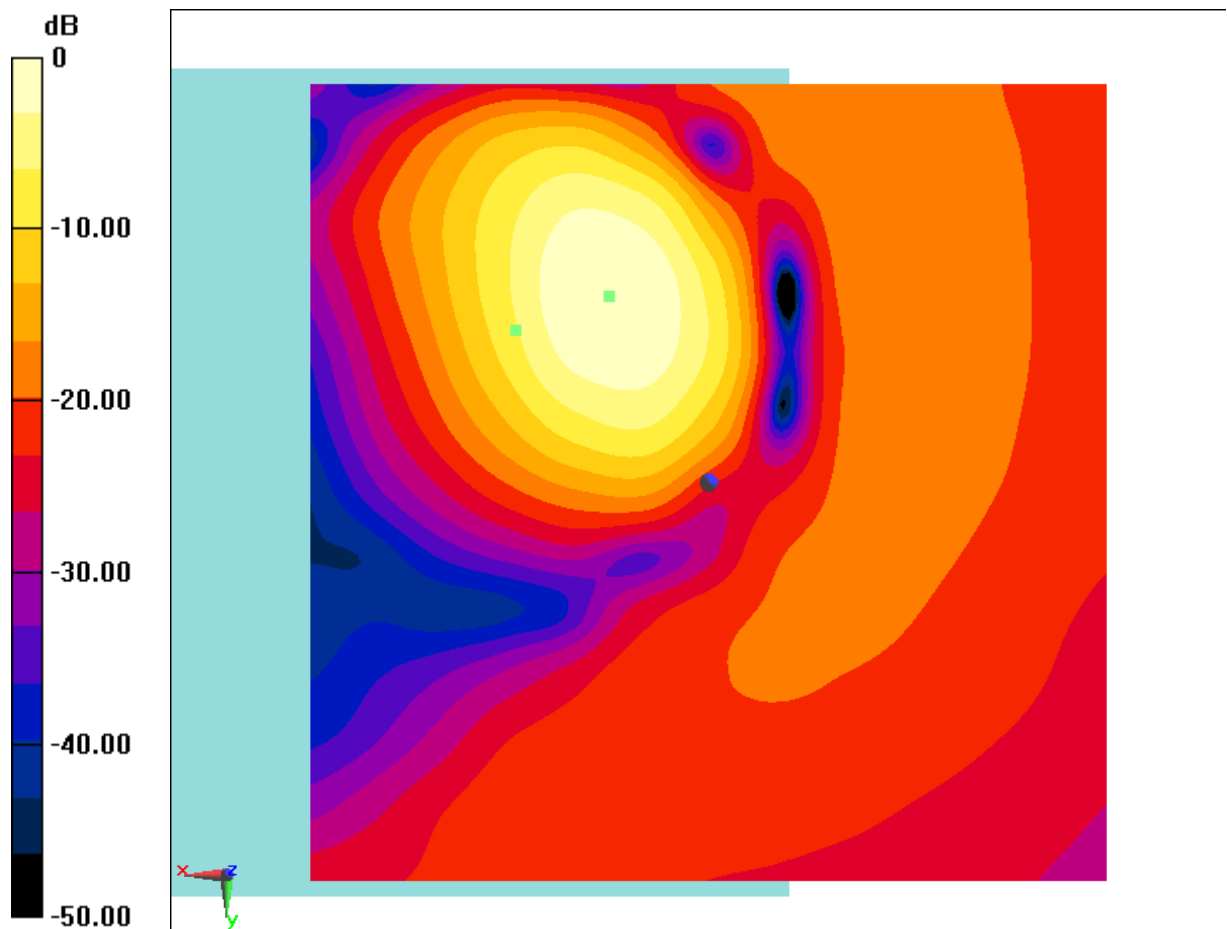
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 37.13 dB

ABM1 comp = 0.29 dBA/m

BWC Factor = 0.16 dB  
Location: 6.3, -11.7, 3.7 mm



0 dB = 1.894 A/m = 5.55 dBA/m

**Fig B.20 T-Coil LTE B66**



**T-Coil LTE WiFi-2.4G 11b Transverse**

Date: 2018-7-24

Electronics: DAE4 Sn786

Medium: Air

Medium parameters used:  $\sigma = 0$  mho/m,  $\epsilon_r = 1$ ;  $\rho = 1$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C

Communication System: WiFi-2.4G; Frequency: 2437 MHz; Duty Cycle: 1:1

Probe: AM1DV3 - 3086;

**T-Coil/General Scans-zhu/y (transversal) 4.2mm 50 x 50/ABM**

**Interpolated Signal(x, y, z) (101x101x1):** Interpolated grid: dx=1.000 mm,

dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1 = -5.96 dBA/m

BWC Factor = 0.16 dB

Location: 9.5, 0, 3.7 mm

**T-Coil/General Scans-zhu/y (transversal) 4.2mm 50 x 50/ABM**

**Interpolated SNR(x, y, z) (101x101x1):** Interpolated grid: dx=1.000 mm,

dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

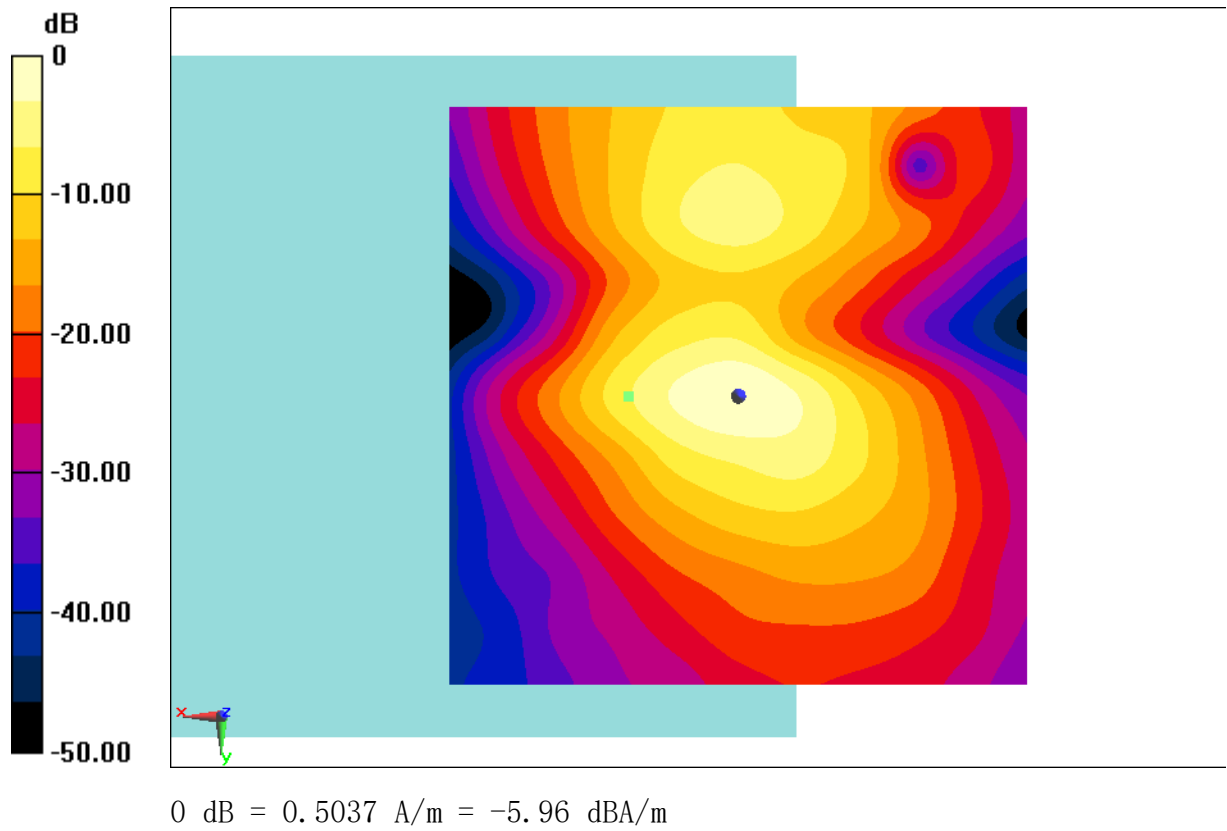
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 33.38 dB

ABM1 comp = -11.48 dBA/m

BWC Factor = 0.16 dB  
Location: 0, 0, 3.7 mm



**Fig B.21 T-Coil WiFi-2. 4G**



**T-Coil WiFi-2.4G 11b Perpendicular**

Date: 2018-7-24

Electronics: DAE4 Sn786

Medium: Air

Medium parameters used:  $\sigma = 0$  mho/m,  $\epsilon_r = 1$ ;  $\rho = 1$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C

Communication System: WiFi-2.4G; Frequency: 2437 MHz; Duty Cycle: 1:1

Probe: AM1DV3 - 3086;

**T-Coil/General Scans-zhu/z (axial) 4.2mm 50 x 50/ABM Interpolated**

**Signal(x, y, z) (101x101x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1 = 2.17 dBA/m

BWC Factor = 0.16 dB

Location: 8.5, -8, 3.7 mm

**T-Coil/General Scans-zhu/z (axial) 4.2mm 50 x 50/ABM Interpolated**

**SNR(x, y, z) (101x101x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Signal Type: Audio File (.wav) 48k\_voice\_1kHz\_1s.wav

Output Gain: 100

Measure Window Start: 300ms

Measure Window Length: 1000ms

BWC applied: 0.16 dB

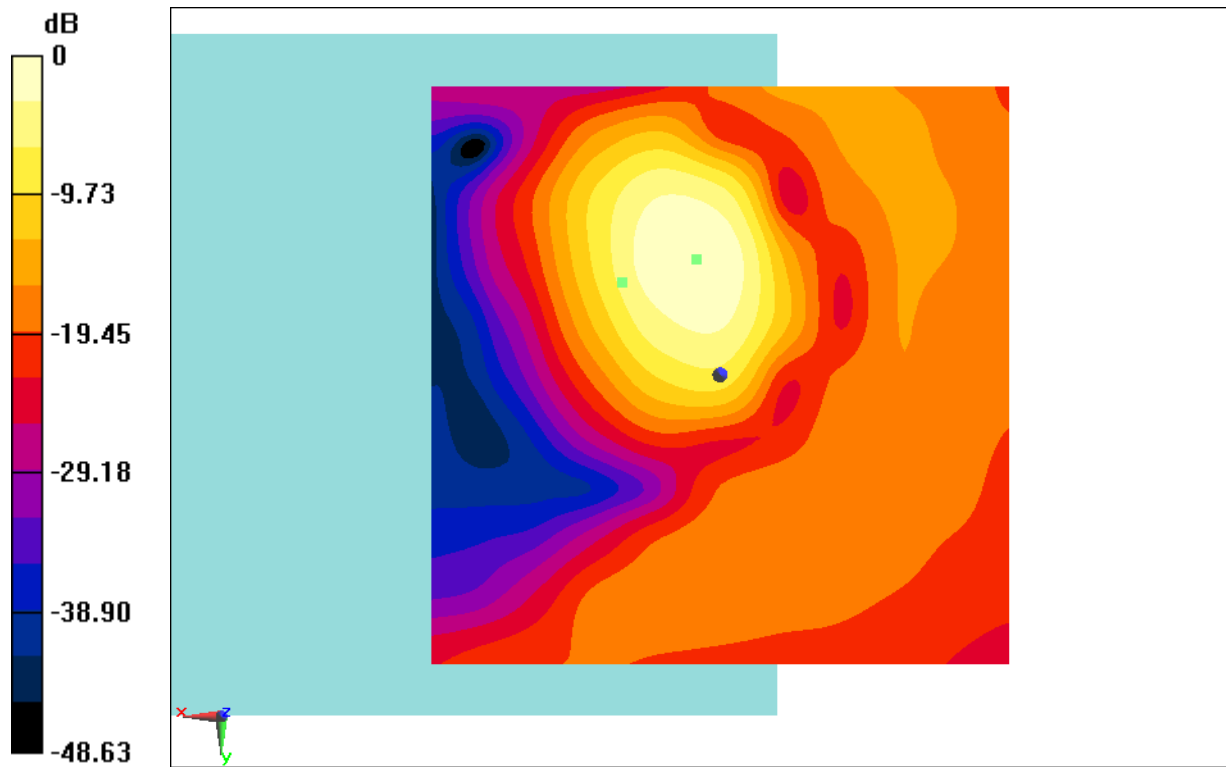
Device Reference Point: 0, 0, -6.3 mm

**Cursor:**

ABM1/ABM2 = 35.50 dB

ABM1 comp = -3.73 dBA/m

BWC Factor = 0.16 dB  
Location: 2, -10, 3.7 mm



0 dB = 1.284 A/m = 2.17 dBA/m

**Fig B.22 T-Coil WiFi-2.4G**

### ANNEX C FREQUENCY REPOSE CURVES

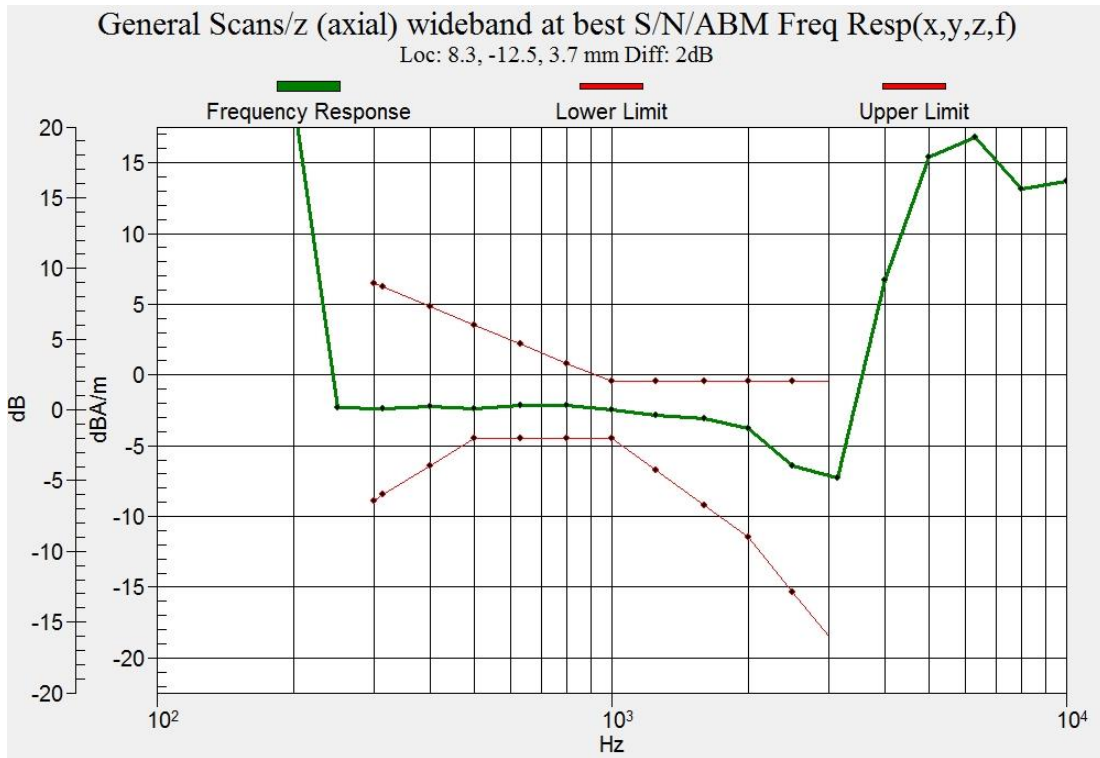


Figure C.1 Frequency Response of GSM 850

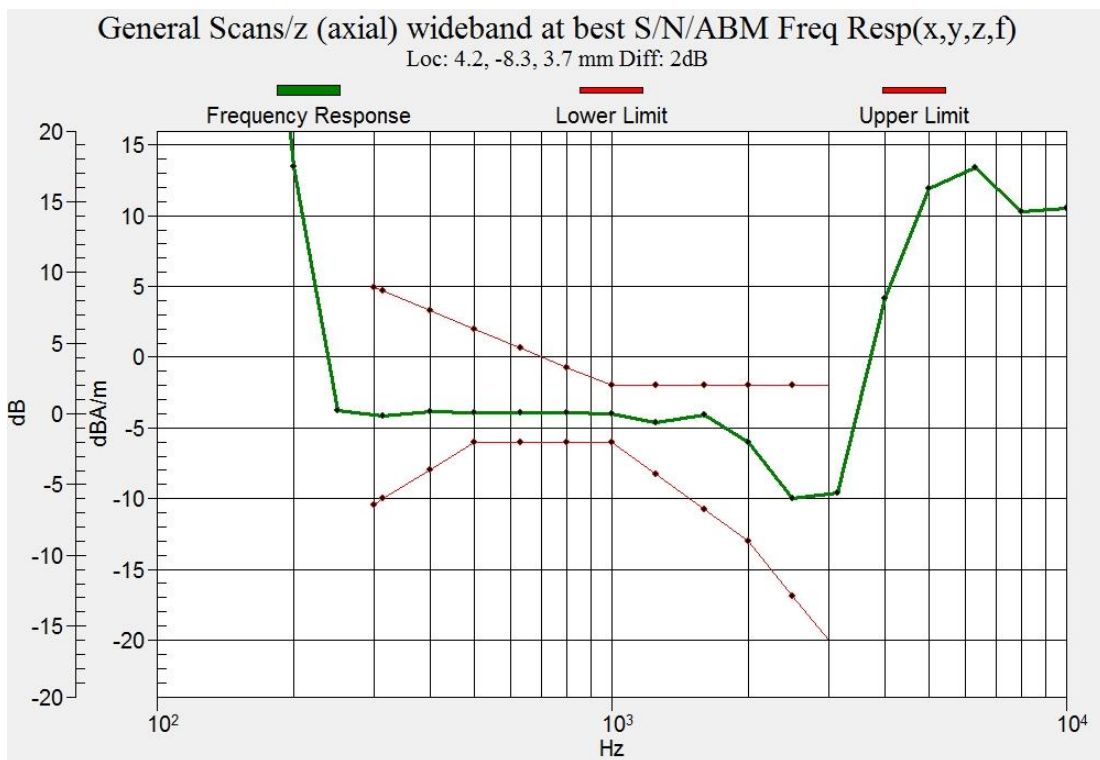
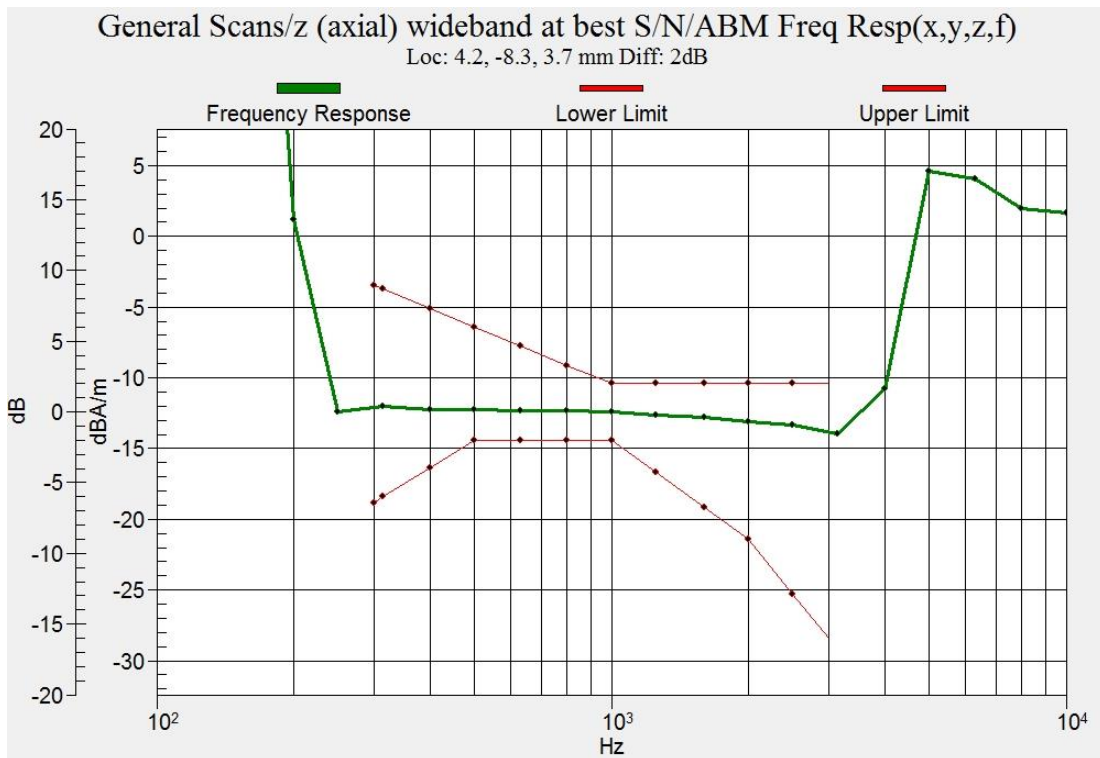
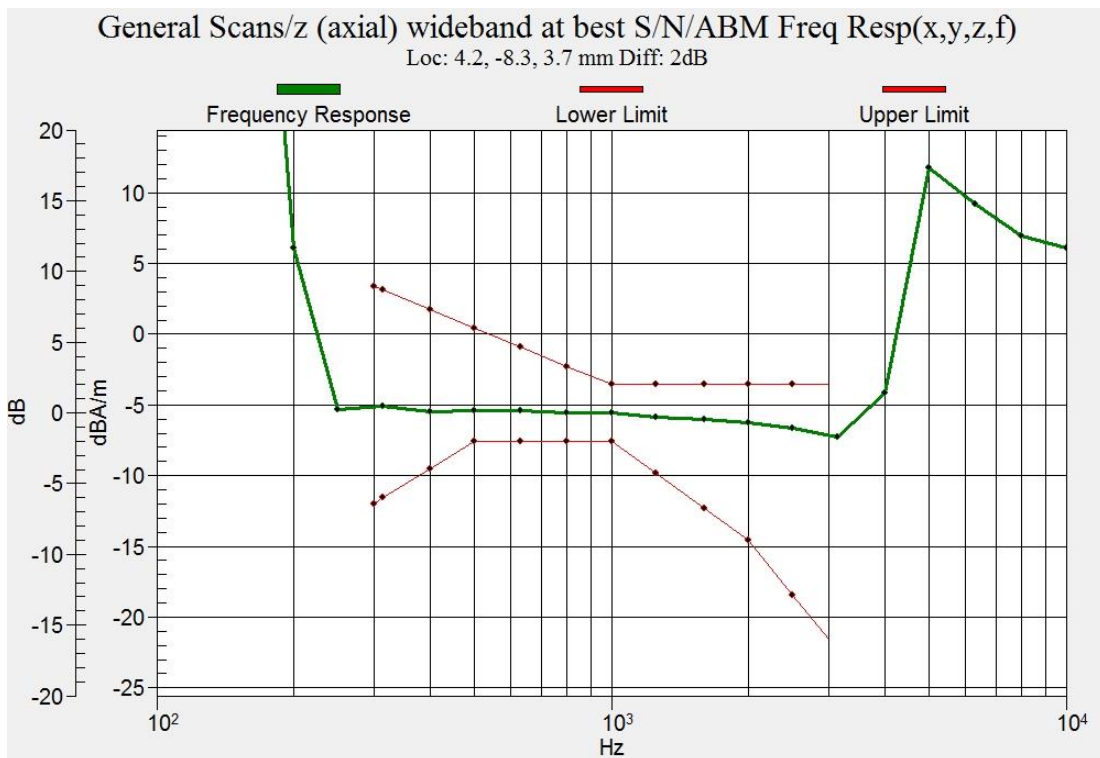


Figure C.2 Frequency Response of GSM 1900

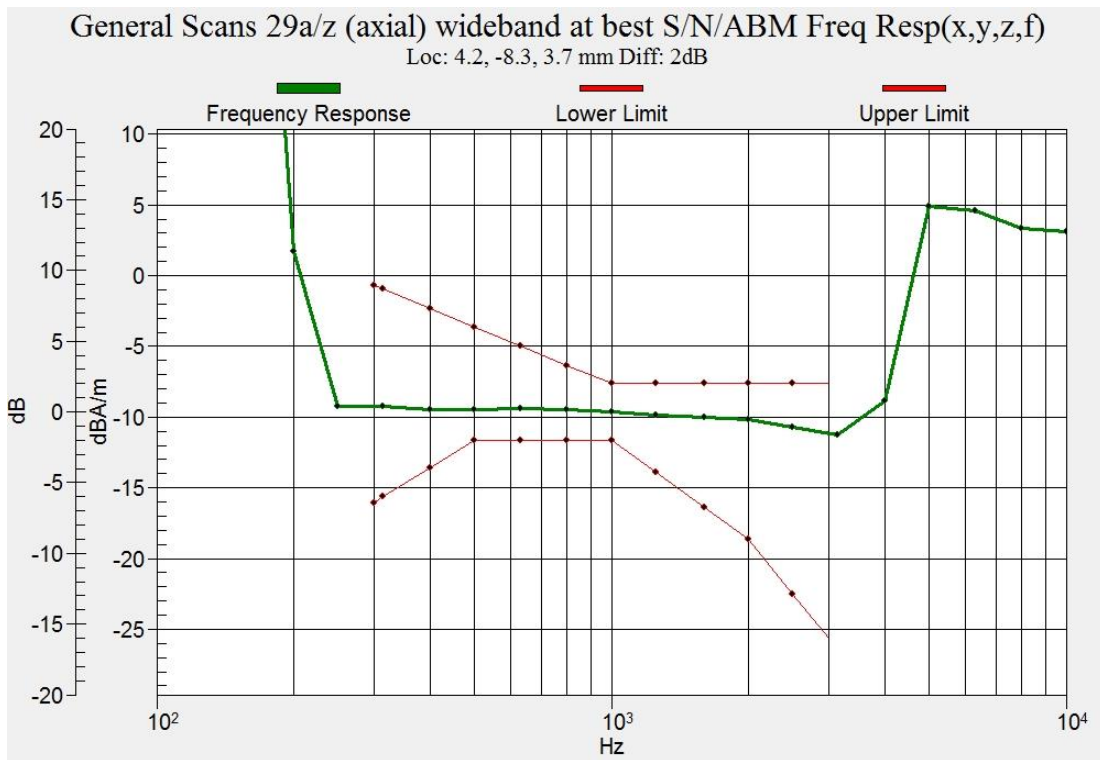




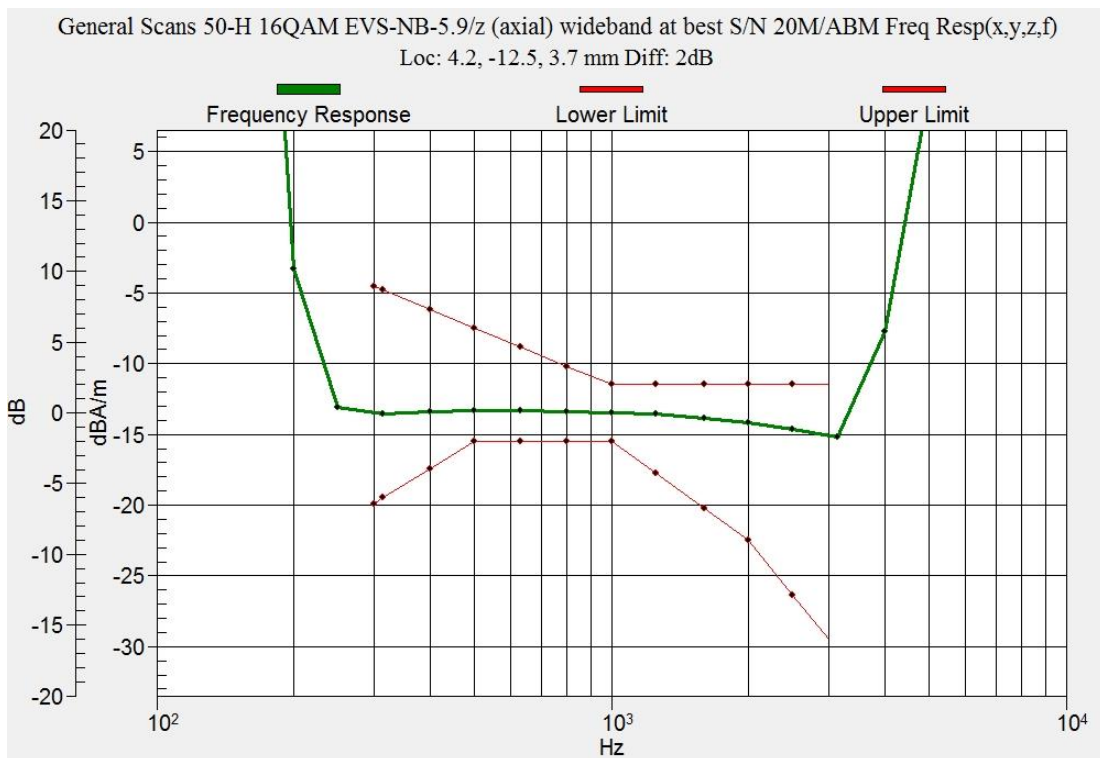
**Figure C.3 Frequency Response of WCDMA 850**



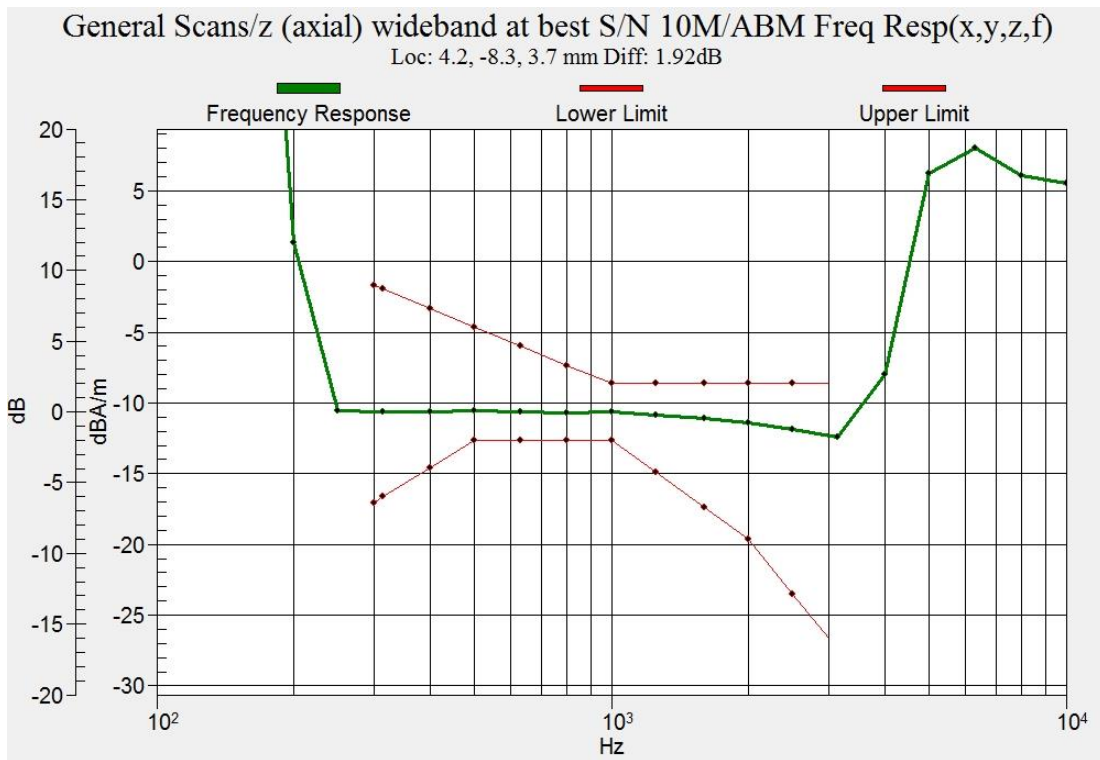
**Figure C.4 Frequency Response of WCDMA 1900**



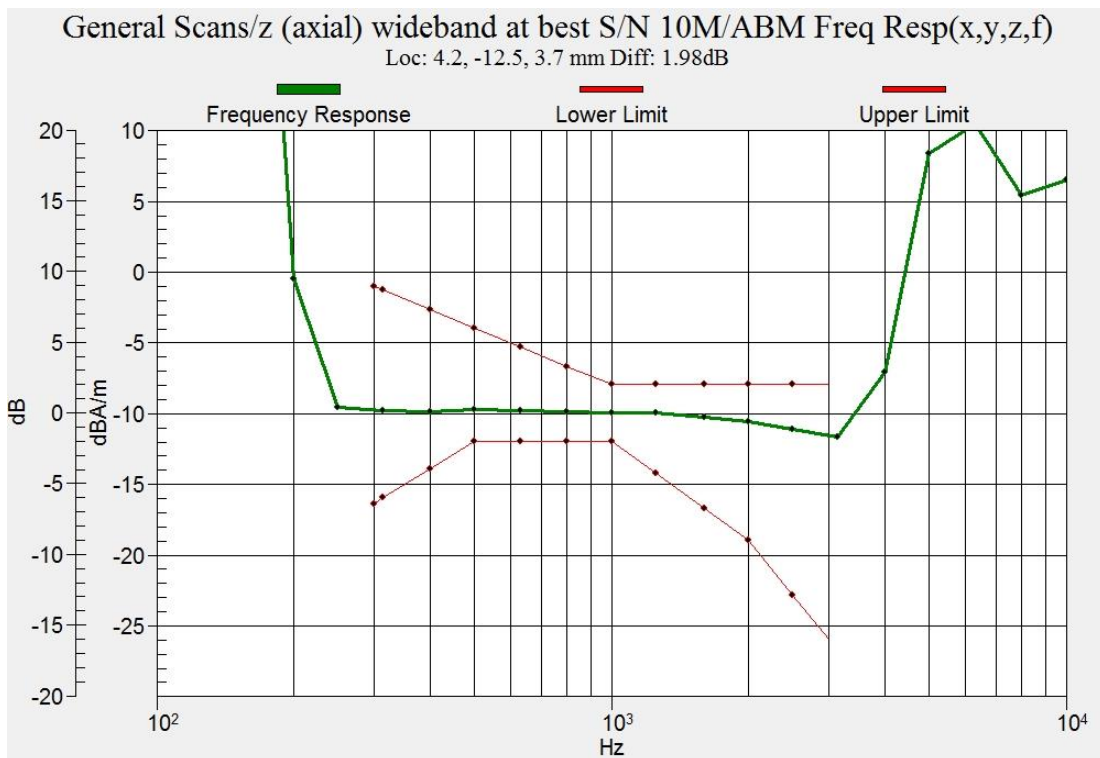
**Figure C.5 Frequency Response of WCDMA 1700**



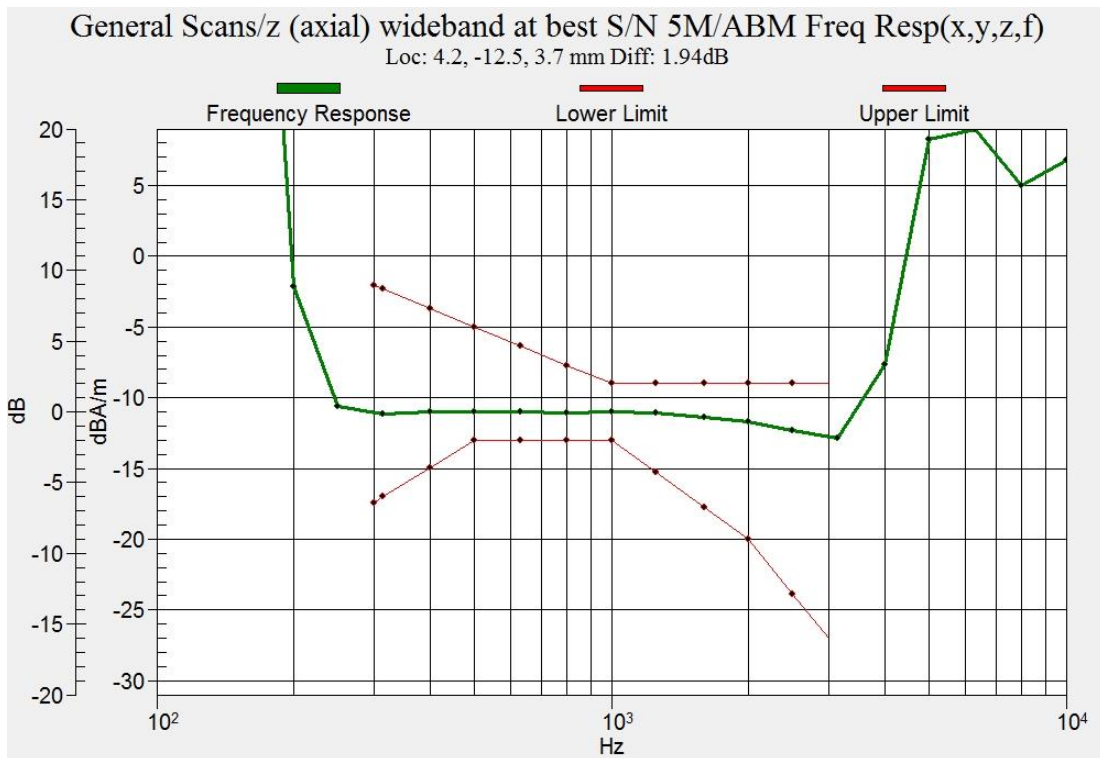
**Figure C.6 Frequency Response of LTE B2**



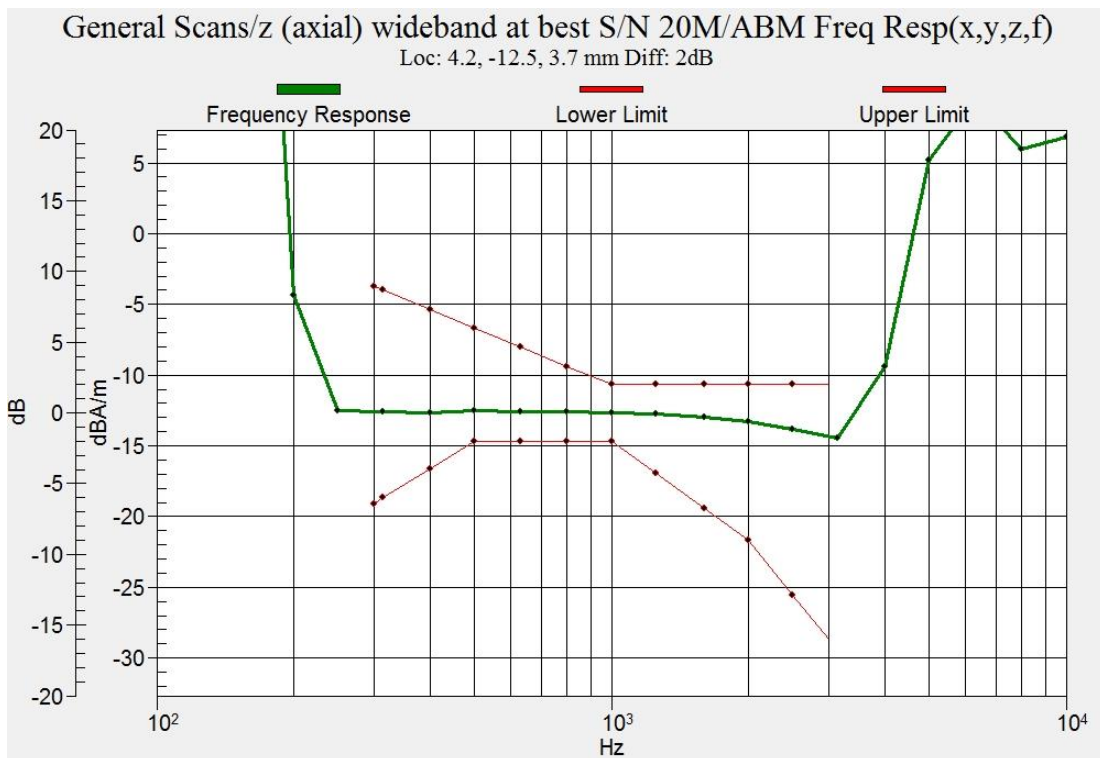
**Figure C.7 Frequency Response of LTE B5**



**Figure C.8 Frequency Response of LTE B12**



**Figure C.9 Frequency Response of LTE B13**



**Figure C.10 Frequency Response of LTE B66**

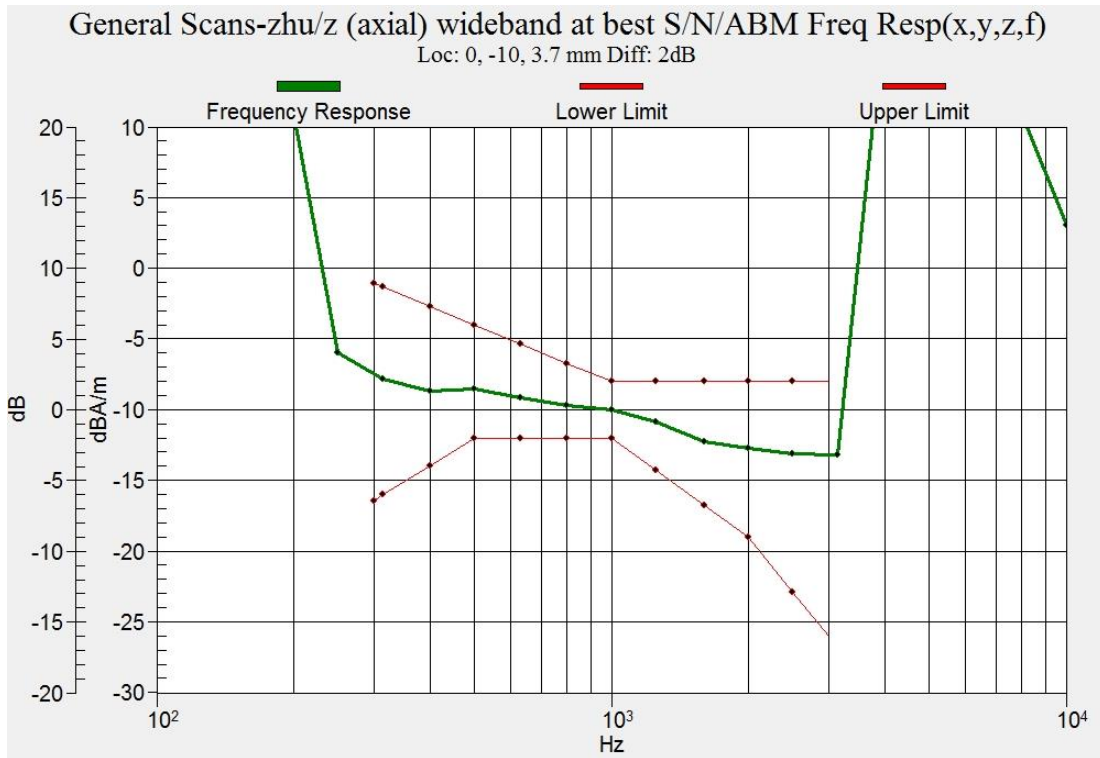


Figure C.11 Frequency Response of WiFi-2.4G



## ANNEX D PROBE CALIBRATION CERTIFICATE

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



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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 **CTTL-BJ (Auden)**

Certificate No: **AM1DV2-1064\_Jul17**

### CALIBRATION CERTIFICATE

Object: **AM1DV2 - SN: 1064**

Calibration procedure(s): **QA CAL-24.v4  
Calibration procedure for AM1D magnetic field probes and TMFS in the audio range**

Calibration date: **July 20, 2017**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°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	09-Sep-16 (No. 19065)	Sep-17
Reference Probe AM1DV2	SN: 1008	30-Dec-16 (No. AM1D-1008_Dec16)	Dec-17
DAE4	SN: 781	13-Jul-17 (No. DAE4-781_Jul17)	Jul-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
AMCC	SN: 1050	01-Oct-13 (in house check Sep-15)	Oct-17
AMMI Audio Measuring Instrument	SN: 1062	26-Sep-12 (in house check Sep-15)	Oct-17

Calibrated by: **Name: Claudio Leubler, Function: Laboratory Technician, Signature: [Signature]**

Approved by: **Name: Katja Pokovic, Function: Technical Manager, Signature: [Signature]**

Issued: July 20, 2017

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

## [References

- [1] ANSI-C63.19-2007  
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.
- [2] 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	<b>AM1DV2</b> Audio Magnetic 1D Field Probe
Type No	SP AM1 001 AF
Serial No	<b>1064</b>

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
Manufacturing date	November 06, 2007
Last calibration date	July 22, 2016

**Calibration data**

Connector rotation angle	(in DASY system)	<b>104.1 °</b>	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	<b>0.44 °</b>	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	<b>0.0657 V / (A/m)</b>	+/- 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%.



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Zeughausstrasse 43, 8004 Zurich, Switzerland



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**S** Swiss Calibration Service

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **CTTL-SZ (Auden)**

Certificate No: **AM1DV3-3086\_Feb18**

### CALIBRATION CERTIFICATE

Object: **AM1DV3 - SN: 3086**

Calibration procedure(s): **QA CAL-24.v4  
Calibration procedure for AM1D magnetic field probes and TMFS in the  
audio range**

Calibration date: **February 22, 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	31-Aug-17 (No. 21092)	Aug-18
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

Calibrated by:	Name <b>Leif Klysner</b>	Function Laboratory Technician	Signature 
Approved by:	Name <b>Katja Pokovic</b>	Function Technical Manager	Signature 

Issued: February 23, 2018

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#### [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	<b>AM1DV3</b> Audio Magnetic 1D Field Probe
Type No	SP AM1 001 BA
Serial No	<b>3086</b>

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
Manufacturing date	May 28, 2010

**Calibration data**

Connector rotation angle	(in DASY system)	<b>204.7°</b>	+/- 3.6 ° (k=2)
Sensor angle	(in DASY system)	<b>0.95 °</b>	+/- 0.5 ° (k=2)
Sensitivity at 1 kHz	(in DASY system)	<b>0.00743 V / (A/m)</b>	+/- 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 DAE CALIBRATION CERTIFICATE

**Calibration Laboratory of  
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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 **CTTL (Auden)**

Certificate No: **DAE4-777\_Sep17**

### CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BM - SN: 777**

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



Calibration date: **September 08, 2017**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	31-Aug-17 (No:21092)	Aug-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-17 (in house check)	In house check: Jan-18
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-17 (in house check)	In house check: Jan-18

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	

Issued: September 8, 2017

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

### Glossary

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

### Methods Applied and Interpretation of Parameters

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



**DC Voltage Measurement**

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	405.400 $\pm$ 0.02% (k=2)	405.869 $\pm$ 0.02% (k=2)	405.579 $\pm$ 0.02% (k=2)
Low Range	3.96640 $\pm$ 1.50% (k=2)	3.96264 $\pm$ 1.50% (k=2)	4.00499 $\pm$ 1.50% (k=2)

**Connector Angle**

Connector Angle to be used in DASY system	97.0 $^{\circ}$ $\pm$ 1 $^{\circ}$
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**Appendix (Additional assessments outside the scope of SCS0108)**

**1. DC Voltage Linearity**

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	200022.73	-12.42	-0.01
Channel X + Input	20003.49	-1.25	-0.01
Channel X - Input	-19998.82	6.77	-0.03
Channel Y + Input	200025.10	-10.04	-0.01
Channel Y + Input	20007.22	2.54	0.01
Channel Y - Input	-20002.34	3.30	-0.02
Channel Z + Input	200028.10	-6.82	-0.00
Channel Z + Input	20002.36	-2.19	-0.01
Channel Z - Input	-20003.64	2.12	-0.01

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2000.54	-0.37	-0.02
Channel X + Input	201.37	0.50	0.25
Channel X - Input	-199.19	-0.20	0.10
Channel Y + Input	1999.95	-0.89	-0.04
Channel Y + Input	200.04	-0.75	-0.37
Channel Y - Input	-199.96	-0.85	0.43
Channel Z + Input	2001.05	0.20	0.01
Channel Z + Input	199.88	-0.86	-0.43
Channel Z - Input	-200.02	-0.88	0.44

**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 ( $\mu\text{V}$ )	Low Range Average Reading ( $\mu\text{V}$ )
Channel X	200	5.45	3.79
	- 200	3.93	0.83
Channel Y	200	7.70	7.39
	- 200	-9.52	-8.90
Channel Z	200	7.51	6.49
	- 200	-9.21	-8.71

**3. Channel separation**

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

	Input Voltage (mV)	Channel X ( $\mu\text{V}$ )	Channel Y ( $\mu\text{V}$ )	Channel Z ( $\mu\text{V}$ )
Channel X	200	-	-1.61	-2.84
Channel Y	200	8.30	-	0.46
Channel Z	200	6.69	5.02	-

**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	15919	14652
Channel Y	16343	14477
Channel Z	16033	14911

**5. Input Offset Measurement**

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec  
Input 10M $\Omega$

	Average ( $\mu$ V)	min. Offset ( $\mu$ V)	max. Offset ( $\mu$ V)	Std. Deviation ( $\mu$ V)
Channel X	-0.50	-2.04	0.95	0.51
Channel Y	1.56	0.40	2.80	0.48
Channel Z	0.26	-0.78	1.16	0.42

**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





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校准  
CALIBRATION  
CNAS L0570

Client : **CTTL(South Branch)**

Certificate No: **Z17-97239**

### CALIBRATION CERTIFICATE

Object: **DAE4 - SN: 786**

Calibration Procedure(s): **FF-Z11-002-01  
Calibration Procedure for the Data Acquisition Electronics (DAEx)**

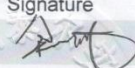
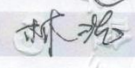

Calibration date: **November 22, 2017**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	27-Jun-17 (CTTL, No.J17X05859)	June-18

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

Issued: November 25, 2017

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



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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: +86-10-62304633-2218 Fax: +86-10-62304633-2209  
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	404.138 ± 0.15% (k=2)	404.330 ± 0.15% (k=2)	404.714 ± 0.15% (k=2)
Low Range	3.97217 ± 0.7% (k=2)	3.97384 ± 0.7% (k=2)	3.95842 ± 0.7% (k=2)

**Connector Angle**

Connector Angle to be used in DASY system	229.5° ± 1 °
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**The photos of HAC test are presented in the additional document:**

Appendix to test report no. I18Z60544-SEM02/03

The photos of HAC test