# HEARING AID COMPATIBILITY T-COIL TEST REPORT

| | |
|---|---|
| **FCC ID** | **: 2AJOTTA-1093** |
| **Equipment** | **: GSM/WCDMA/LTE Mobile Phone** |
| **Brand Name** | **: Nokia** |
| **T-Rating** | **: T3** |
| **Applicant** | **: HMD Global Oy<br>Karaportti 2 02610 Espoo FINLAND** |
| **Manufacturer** | **: HMD Global Oy<br>Karaportti 2 02610 Espoo FINLAND** |
| **Standard** | **: FCC 47 CFR §20.19<br>ANSI C63.19-2011** |

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

**The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.**

**The test results in this variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERTIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.**

Jones Tsai

**Approved by: Jones Tsai / Manager**

***SPORTON INTERTIONAL INC. EMC & Wireless Communications Laboratory***
*No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)*

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# History of this test report

| Report No. | Version | Description | Issued Date |
|---|---|---|---|
| HA832104-01B | Rev. 01 | Initial issue of report | Jun. 13, 2018 |
| | | | |
| | | | |

# 1. General Information

| Product Feature & Specification | |
|---|---|
| **Applicant Name** | HMD Global Oy |
| **Equipment Name** | GSM/WCDMA/LTE Mobile Phone |
| **Brand Name** | Nokia |
| **FCC ID** | 2AJOTTA-1093 |
| **HW Version** | HW0343 |
| **SW Version** | 000C_0_146 |
| **EUT Stage** | Identical prototype |
| **Exposure category** | General Population/Uncontrolled Exposure |
| **Date Tested** | 2018/05/17 ~ 2018/06/08 |
| **Frequency Band** | GSM850: 824.2 MHz ~ 848.8 MHz<br>GSM1900: 1850.2 MHz ~ 1909.8 MHz<br>WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz<br>WCDMA Band IV: 1712.4 MHz ~ 1752.6 MHz<br>WCDMA Band V: 826.4 MHz ~ 846.6 MHz<br>LTE Band 2: 1850.7 MHz ~ 1909.3 MHz<br>LTE Band 4 : 1710.7 MHz ~ 1754.3 MHz<br>LTE Band 5: 824.7 MHz ~ 848.3 MHz<br>LTE Band 7: 2502.5 MHz ~ 2567.5 MHz<br>LTE Band 12: 699.7 MHz ~ 715.3 MHz<br>LTE Band 13: 779.5 MHz ~ 784.5 MHz<br>LTE Band 17: 706.5 MHz ~ 713.5 MHz<br>LTE Band 38: 2572.5 MHz ~ 2617.5 MHz<br>LTE Band 66: 1710.7 MHz ~ 1779.3 MHz<br>WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz<br>Bluetooth: 2402 MHz ~ 2480 MHz |
| **Mode** | GSM/GPRS/EGPRS<br>RMC/AMR 12.2Kbps<br>HSDPA<br>HSUPA<br>HSPA+ (16QAM uplink is not supported)<br>LTE: QPSK, 16QAM<br>WLAN 2.4GHz : 802.11b/g/n HT20/HT40<br>Bluetooth v3.0+EDR, Bluetooth v4.0 LE, Bluetooth v4.1 LE, Bluetooth v4.2 LE |

**Remark:** This is a change ID application base on FCC ID: 2AJOTTA-1084(Sporton report number HA832104B), TA-1093 is single SIM card mobile and original model TA-1084 is dual SIM cards mobile. We evaluate that there has no effect on HAC distribution, so all the test results release from original report which can be referred to Sporton report number HA832104B, FCC ID: 2AJOTTA-1084).

**Reviewed by: Eric Huang**
**Report Producer: Wan Liu**

## 2. Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190) and the FCC designation No. TW1190 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test.

| Testing Laboratory | |
|---|---|
| Test Site | SPORTON INTERNATIONAL INC. |
| Test Site Location | No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)<br>TEL: +886-3-327-3456<br>FAX: +886-3-328-4978 |
| Test Site No. | Sporton Site No.:<br>**SAR04-HY** |

## 3. Applied Standards

- FCC CFR47 Part 20.19
- ANSI C63.19 2011-version
- FCC KDB 285076 D01 HAC Guidance v05
- FCC KDB 285076 D02 T Coil testing v03
- FCC KDB 285076 D03 HAC FAQ v01

# 4. Air Interface and Operating Mode

| Air Interface | Band MHz | Type | C63.19 Tested | Simultaneous Transmitter | Name of Voice Service | Power Reduction |
|---|---|---|---|---|---|---|
| GSM | GSM850 | VO | Yes | WLAN, BT | CMRS Voice | No |
| | GSM1900 | | | WLAN, BT | | No |
| | EDGE850 | VD | Yes | WLAN, BT | Google Duo[1] / SIP calling[1,2] | No |
| | EDGE1900 | | | | | |
| UMTS | 850 | VO | Yes | WLAN, BT | CMRS Voice | No |
| | 1750 | | | WLAN, BT | | No |
| | 1900 | | | WLAN, BT | | No |
| | HSPA | VD | Yes | WLAN, BT | Google Duo[1] / SIP calling[1,2] | No |
| LTE (FDD) | Band 2 | VD | Yes | WLAN, BT | VoLTE / Google Duo[1] / SIP calling[1,2] | No |
| | Band 4 | | | WLAN, BT | | No |
| | Band 5 | | | WLAN, BT | | No |
| | Band 7 | | | WLAN, BT | | No |
| | Band 12 | | | WLAN, BT | | No |
| | Band 13 | | | WLAN, BT | | No |
| | Band 17 | | | WLAN, BT | | No |
| | Band 66 | | | WLAN, BT | | No |
| LTE (TDD) | Band 38 | VD | Yes | WLAN, BT | VoLTE / Google Duo[1] / SIP calling[1,2] | No |
| Wi-Fi | 2450 | VD | Yes | GSM,WCDMA,LTE | Google Duo[1] / SIP calling[1,2] | No |
| | | | | | | No |
| BT | 2450 | DT | No | GSM,WCDMA,LTE | NA | No |

**Type Transport:**
VO= Voice only
DT= Digital Transport only (no voice)
VD= CMRS and IP Voice Service over Digital Transport

**Remark:**
1. For protocols not listed in Table 7.1 of ANSI C63.19-2011 or the ANSI C63.19-2011 VoLTE interpretation, the average speech level of −20 dBm0 should be used.
2. The SIP calling is android internal auxiliary functions under the dialing program.

# 5. Measurement standards for T-Coil

## 5.1 Frequency Response

The frequency response of the perpendicular component of the magnetic field, measured in 1/3 octave bands, shall follow the response curve specified in this sub-clause, over the frequency range 300 Hz to 3000 Hz.
Figure 1.1 and Figure 1.2 provide the boundaries as a function of frequency. These response curves are for true field-strength measurements of the T-Coil signal. Thus, the 6 dB/octave probe response has been corrected from the raw readings.

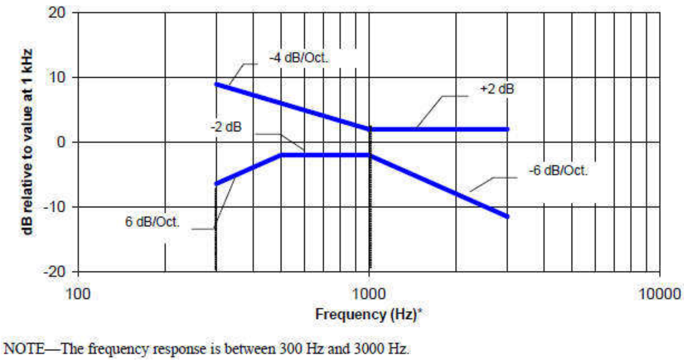



**Fig. 1.1 Magnetic field frequency response for WDs with field strength≤-15dB at 1 KHz**

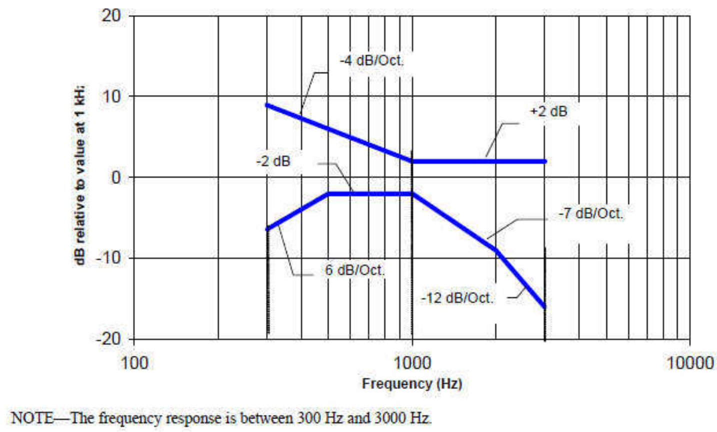



**Fig. 1.2 Magnetic field frequency response for WDs with a field that exceeds –15 dB(A/m) at 1 kHz**

## 5.2 T-Coil Signal Quality Categories

This section provides the signal quality requirement for the intended T-Coil signal from a WD. Only the RF immunity of the hearing aid is measured in T-Coil mode. It is assumed that a hearing aid can have no immunity to an interference signal in the audio band, which is the intended reception band for this mode. A device is assessed beginning by determining the category of the RF environment in the area of the T-Coil source.
The RF measurements made for the T-Coil evaluation are used to assign the category T1 through T4. The limitation is given in Table 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 dB) |
|---|---|
| Category T1 | 0 to 10 dB |
| Category T2 | 10 to 20 dB |
| Category T3 | 20 to 30 dB |
| Category T4 | > 30 dB |

**Table 1 T-Coil Signal Quality Categories**

# 6. T-Coil Test Procedure

Referenced to ANSI C63.19-2011, Section 7.4,

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

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

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

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

a. A validation of the test setup and instrumentation may be performed using a TMFS or Helmholtz coil Measure the emissions and confirm that they are within the specified tolerance.
b. Position the WD in the test setup and connect the WD RF connector to a base station simulator or a non-radiating load. Confirm that equipment that requires calibration has been calibrated, and that the noise level meets the requirements given in ANSI C63.19-2011 clause 7.3.1.
c. The drive level to the WD ise set such that the reference input level specified in ANSI C63.19-2011 Table 7.1 is input to the base station simulator (or manufacturer's test mode equivalent) in 1 kHz, 1/3 octave band. This drive level shall be used for the T-Coil signal test (ABM1) at f = 1 kHz. Either a sine wave at 1025 Hz or a voice-like signal, band-limited to the 1 kHz 1/3 octave, as defined in ANSI C63.19-2011 clause 7.4.2, shall be used for the reference audio signal. If interference is found at 1025 Hz an alternative nearby reference audio signal frequency may be used. The same drive level shall be used for the ABM1 frequency response measurements at each 1/3 octave band center frequency. The WD volume control may be set at any level up to maximum, provided that a signal at any frequency at maximum modulation would not result in clipping or signal overload.
d. Determine the magnetic measurement locations for the WD device (A.3), if not already specified by the manufacturer, as described in ANSI C63.19-2011 clause 7.4.4.1.1 and 7.4.4.2.
e. At each measurement location, measure and record the desired T-Coil magnetic signals (ABM1 at 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.
f. 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.)
g. 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.
h. 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).
i. 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.

## 6.1 Test Flow Chart

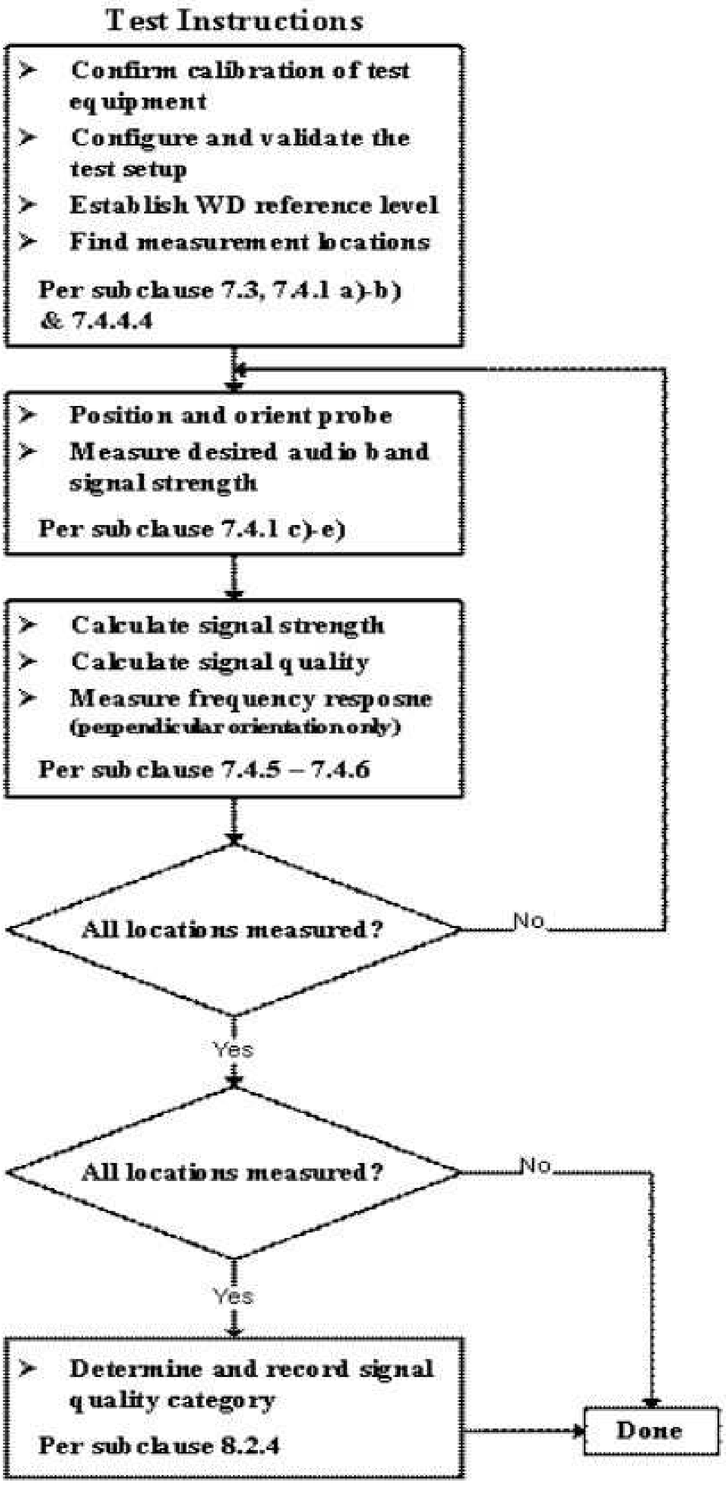
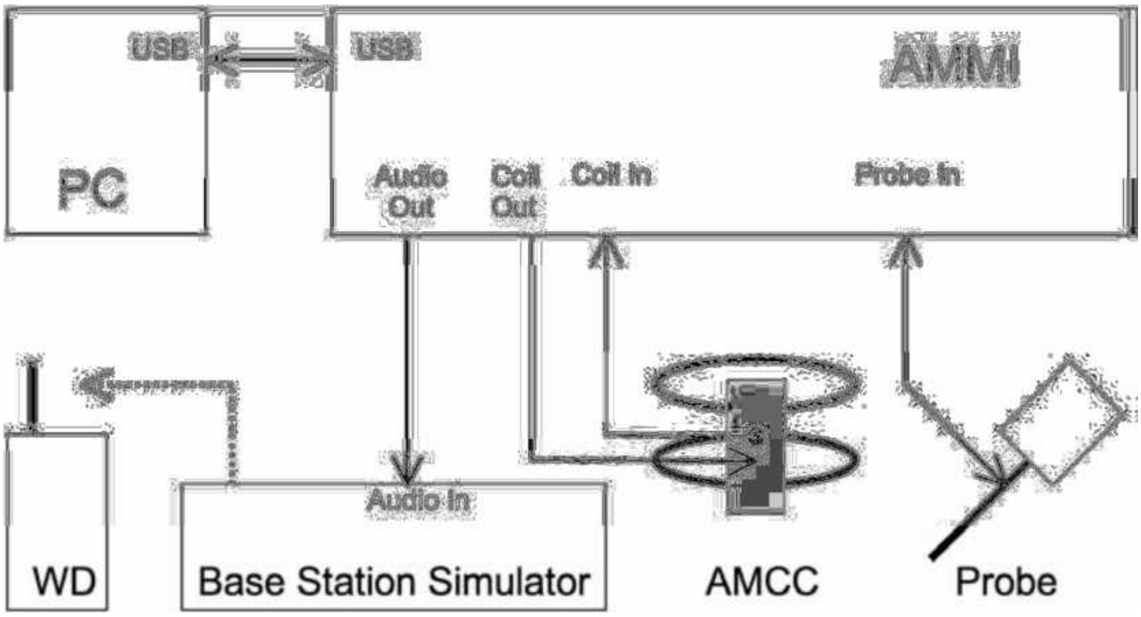



**Fig. 2 T-Coil Signal Test flowchart**

## 6.2 Test Setup Diagram




**General Note:**

1. Define the all applicable input audio level as below according to C63.19 and KDB 285076 D02v03:
   - GSM input level: -16dBm0
   - UMTS input level: -16dBm0
   - VoLTE input level: -16dBm0
   - OTT VoIP input Level: -20dBm0
2. For GSM / UMTS test setup and input level, the correct input level definition is via a communication tester CMU200's "Decoder Cal" and "Codec Cal" with audio option B52 and B85 to set the correct audio input levels.
3. CMU200 is able to output 1kHz audio signal equivalent to 3.14dBm0 at "Decoder Cal." confuguration, the signal reference is used to adjust the AMMI gain setting to reach -16dBm0 for GSM/UMTS. CMW500 input is calibrated and the relation between the analog input voltage and the internal level in dBm0 can be determined.
4. The test setup used for VoLTE over IMS is via the callbox of CMW500 for T-coil measurement, The data application unit of the CMW500 was used to simulate the IP multimedia subsystem server. The CMW500 can be manually configured to ensure and control the speech input level result is -16dBm0 for VoLTE when the device during the IMS connection.
5. The test setup used for Google DUO VoIP call is via the data application unit on CMW500 connection to the Internet, also connection to the other auxiliary VoIP unit which is used to configure the audio codec and bit rate and also monitor the audio input level of -20dBm0.

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 below calculation formula is an example and showing how to determine the input level for the 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.

Calculation formula:
- Audio Level at -16dBm0 = ((-16dBm0) – (3.14dBm0)) + X dBv
- Calculated Gain at -16dBm0 = 10(( audio level at -16dBm0 – Y dBm0) / 20) * 10
- Gatting setting at -16dBm0 = required gain factor * calculated gain

| Gain Value | 20* log(gain) | AMCC Coil In | Level |
|---|---|---|---|
| (linear) | dB | (dBv RMS) | dBm0 |
| | | -2.47 | 3.14 |
| 10 | 20 | -19.85 | -14.24 |
| 8.17 | 18.24 | -21.61 | -16 |

| Signal Type | Duration (s) | Peak to RMS (dB) | RMS (dB) | Required Gain Factor | Calculated Gain Setting |
|---|---|---|---|---|---|
| 1kHz sine | - | 3 | 0 | 1 | 8.17 |
| 48k_voice_1kHz | 1 | 16.2 | -12.7 | 4.33 | 35.36 |
| 48k_voice_300Hz ~ 3kHz | 2 | 21.6 | -18.6 | 8.48 | 69.25 |

## 6.3 Description of EUT Test Position

Fig.3 illustrate the references and reference plane that shall be used in a typical EUT emissions measurement. The principle of this section is applied to EUT with similar geometry. Please refer to Appendix C for the setup photographs.

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

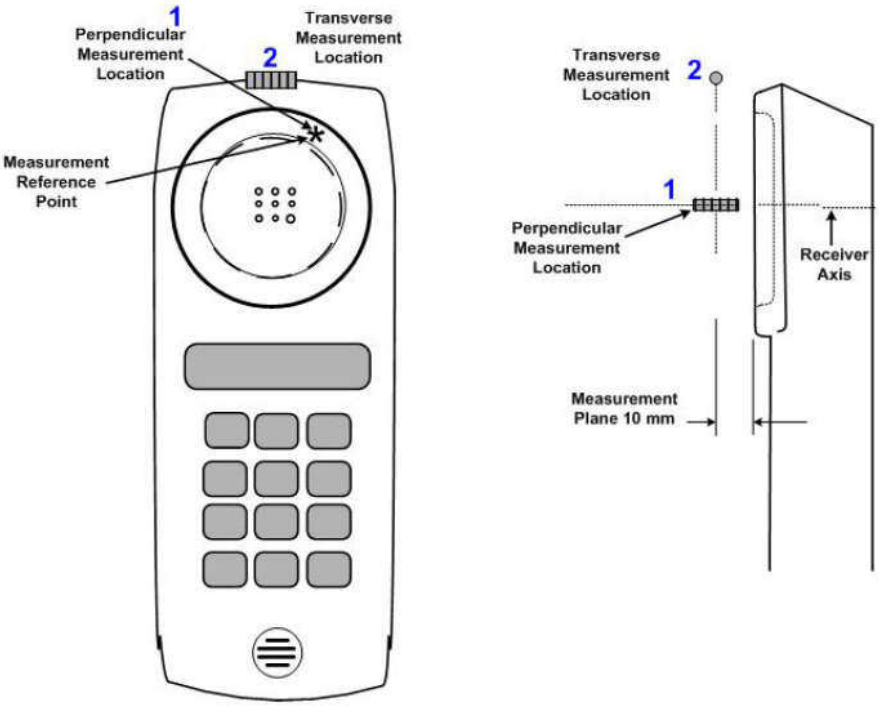



**Fig.3 A typical EUT reference and plane for T-Coil measurements**

# 7. Test Equipment List

| Manufacturer | Name of Equipment | Type/Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Cal. | Due Date |
| SPEAG | Data Acquisition Electronics | DAE4 | 1386 | Jul. 20, 2017 | Jul. 19, 2018 |
| SPEAG | Data Acquisition Electronics | DAE4 | 1279 | Jan. 03, 2018 | Jan. 02, 2019 |
| SPEAG | Data Acquisition Electronics | DAE4 | 1424 | Jan. 18, 2018 | Jan. 17, 2019 |
| SPEAG | Audio Magnetic 1D Field Probe | AM1DV3 | 3106 | Nov. 28, 2017 | Nov. 27, 2018 |
| SPEAG | Active Audio Magnetic Field Probe | AM1DV3 | 3128 | Dec. 20, 2017 | Dec. 19, 2018 |
| SPEAG | Audio Magnetic 1D Field Probe | AM1DV3 | 3130 | Nov. 21, 2017 | Nov. 20, 2018 |
| SPEAG | Audio Magnetic Calibration Coil | AMCC | 1049 | NCR | NCR |
| SPEAG | Audio Measuring Instrument | AMMI | 1041 | NCR | NCR |
| VICTOR | Temperature and humidity meter | VC230 | H-3 | Apr. 15, 2018 | Apr. 14, 2019 |
| SPEAG | Test Arch Phantom | N/A | N/A | NCR | NCR |
| SPEAG | Phone Positioner | N/A | N/A | NCR | NCR |
| Anritsu | Power Senor | MA2411B | 1306099 | Aug. 21, 2017 | Aug. 20, 2018 |
| Anritsu | Power Meter | ML2495A | 1349001 | Jul. 19, 2017 | Jul. 18, 2018 |
| Anritsu | Radio communication analyzer | MT8820C | 6201300653 | Jul. 19, 2017 | Jul. 18, 2018 |
| R&S | Base Station(Measure) | CMU200 | 112569 | Sep. 10, 2017 | Sep. 09, 2018 |
| R&S | Base Station(Measure) | CMU500 | S110702JGE02 | Jul. 19, 2017 | Jul. 18, 2018 |

**Note:** NCR: “No-Calibration Required”

# 8. T-Coil testing for CMRS Voice

**General Note:**

1. The middle channel of each frequency band is used for T-Coil testing according ANSI C63.19 2011.
2. For VoLTE radio configuration investigation is choose either one codec and an investigation was performed on all frequency band, data rates and modulations and RB configuration to determine the radio configuration to be used for testing, the following tests results which the worst case configuration would be remarked to be used for the testing for the handset.
3. Choose worst case from radio configuration investigation. After investigation was performed to determine the audio codec configuration to be used for testing, the following tests results which the worst case codec would be remarked to be used for the testing for the handset.

## 8.1 GSM Tests Results

### <Codec Investigation>

| Codec | FR V1 | HR V1 | Orientation | Band / Channel |
|---|---|---|---|---|
| ABM 1 (dBA/m) | 4.00 | 3.40 | Axial | GSM850 / 189 |
| ABM 2 (dBA/m) | -20.74 | -21.62 | | |
| Freq. Response | Pass | Pass | | |
| Signal Quality (dB) | 24.74 | 25.02 | | |

### <Summary Tests Results>

| Plot No. | Air Interface | Mode | Channel | Probe Position | ABM1 dB (A/m) | ABM2 dB (A/m) | Signal Quality dB | T Rating | Ambient Noise dB (A/m) | Freq. Response Variation dB | Frequency Response |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | GSM850 | Voice(speech codec handset low) | 189 | Axial (Z) | 4.00 | -20.74 | 24.74 | T3 | -50.33 | 2 | Pass |
| | | | | Transversal (Y) | -10.05 | -36.60 | 26.55 | T3 | -50.23 | | |
| 2 | GSM1900 | Voice(speech codec handset low) | 661 | Axial (Z) | 4.13 | -23.26 | 27.39 | T3 | -50.29 | 2 | Pass |
| | | | | Transversal (Y) | -9.64 | -39.05 | 29.41 | T3 | -50.18 | | |

## 8.2 UMTS Tests Results

### <Codec Investigation>

| Codec | AMR 4.75Kbps | AMR 7.95Kbps | AMR 12.2Kbps | Orientation | Band / Channel |
|---|---|---|---|---|---|
| ABM 1 (dBA/m) | -2.94 | -3.03 | -3.06 | Axial | Band 5 / 4182 |
| ABM 2 (dBA/m) | -46.45 | -46.45 | -46.4 | | |
| Freq. Response | Pass | Pass | Pass | | |
| Signal Quality (dB) | 43.51 | 43.42 | 43.34 | | |

### <Summary Tests Results>

| Plot No. | Air Interface | Mode | Channel | Probe Position | ABM1 dB (A/m) | ABM2 dB (A/m) | Signal Quality dB | T Rating | Ambient Noise dB (A/m) | Freq. Response Variation dB | Frequency Response |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | WCDMA V | Voice (speech codec low) | 4182 | Axial (Z) | 2.49 | -42.82 | 45.31 | T4 | -50.30 | 1.86 | Pass |
| | | | | Transversal (Y) | -5.77 | -48.03 | 42.26 | T4 | -50.25 | | |
| 4 | WCDMA IV | Voice (speech codec low) | 1413 | Axial (Z) | 2.91 | -41.97 | 44.88 | T4 | -50.21 | 1.65 | Pass |
| | | | | Transversal (Y) | -6.17 | -47.93 | 41.76 | T4 | -50.27 | | |
| 5 | WCDMA II | Voice (speech codec low) | 9400 | Axial (Z) | -5.32 | -43.10 | 37.78 | T4 | -50.35 | 1.92 | Pass |
| | | | | Transversal (Y) | -10.02 | -44.40 | 34.38 | T4 | -50.23 | | |

## 8.3 VoLTE Tests Results

### <Radio Configuration Investigation>

| Air Interface | Bandwidth (MHz) | Modulation | RB size | RB offset | channel | ABM1 dB (A/m) | ABM2 dB (A/m) | Signal Quality (dB) |
|---|---|---|---|---|---|---|---|---|
| LTE Band 2 | 20 | QPSK | 1 | 0 | 18900 | 0.56 | -42.23 | 42.79 |
| LTE Band 2 | 20 | QPSK | 50 | 0 | 18900 | 1.96 | -41.03 | 42.99 |
| LTE Band 2 | 20 | QPSK | 100 | 0 | 18900 | 1.70 | -43.17 | 44.87 |
| LTE Band 2 | 20 | 16QAM | 1 | 0 | 18900 | 1.98 | -42.22 | 44.20 |
| LTE Band 2 | 15 | QPSK | 1 | 0 | 18900 | 2.14 | -42.83 | 44.97 |
| LTE Band 2 | 10 | QPSK | 1 | 0 | 18900 | 2.00 | -43.08 | 45.08 |
| LTE Band 2 | 5 | QPSK | 1 | 0 | 18900 | 1.93 | -43.20 | 45.13 |
| LTE Band 2 | 3 | QPSK | 1 | 0 | 18900 | 1.91 | -42.85 | 44.76 |
| LTE Band 2 | 1.4 | QPSK | 1 | 0 | 18900 | 2.08 | -42.68 | 44.76 |

### <AMR Codec Investigation>

| Codec | NB AMR 4.75Kbps | WB AMR 6.60Kbps | NB AMR 12.2Kbps | WB AMR 23.85Kbps | Orientation | Band / BW / Channel |
|---|---|---|---|---|---|---|
| ABM 1 (dBA/m) | 0.56 | 0.35 | 1.78 | -0.03 | Axial | B2 / 20M / 18900 |
| ABM 2 (dBA/m) | -42.23 | -42.95 | -42.94 | -43.02 | | |
| Freq. Response | Pass | Pass | Pass | Pass | | |
| Signal Quality (dB) | 42.79 | 43.30 | 44.72 | 42.99 | | |

## <EVS Codec Investigation>

| Codec | EVS SWB 9.6Kbps | EVS SWB 128Kbps | EVS WB 5.9Kbps | EVS WB 128Kbps | EVS NB 5.9Kbps | EVS NB 24.4Kbps | Orientation | Band / BW / Channel |
|---|---|---|---|---|---|---|---|---|
| ABM 1 (dBA/m) | 0.03 | 1.67 | 0.64 | 0.81 | 0.73 | 1.58 | Axial | B2 / 20M / 18900 |
| ABM 2 (dBA/m) | -43.51 | -41.68 | -42.13 | -42.16 | -42.56 | -41.49 | | |
| Freq. Response | Pass | Pass | Pass | Pass | Pass | Pass | | |
| Signal Quality (dB) | 43.54 | 43.35 | 42.77 | 42.97 | 43.29 | 43.07 | | |

## <Summary Tests Results>

| Plot No. | Air Interface | BW (MHz) | Modulation | RB Size | RB offset | Channel | Probe Position | ABM1 dB (A/m) | ABM2 dB (A/m) | Signal Quality dB | T Rating | Ambient Noise dB (A/m) | Freq. Response Variation dB | Frequency Response |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | LTE Band 2 | 20 | QPSK | 1 | 0 | 18900 | Axial (Z) | 0.64 | 49.35 | 42.77 | T4 | -48.71 | 2 | Pass |
| | | | | | | | Transversal (Y) | -5.57 | 42.98 | 38.28 | T4 | -48.55 | | |
| 7 | LTE Band 4 | 20 | QPSK | 1 | 0 | 20175 | Axial (Z) | 1.09 | 50.10 | 42.76 | T4 | -49.01 | 2 | Pass |
| | | | | | | | Transversal (Y) | -8.02 | 40.93 | 36.86 | T4 | -48.95 | | |
| 8 | LTE Band 5 | 10 | QPSK | 1 | 0 | 20525 | Axial (Z) | -0.05 | 48.63 | 43.45 | T4 | -48.68 | 2 | Pass |
| | | | | | | | Transversal (Y) | -8.45 | 40.31 | 38.61 | T4 | -48.76 | | |
| 9 | LTE Band 7 | 20 | QPSK | 1 | 0 | 21100 | Axial (Z) | 0.84 | 49.79 | 43.05 | T4 | -48.95 | 2 | Pass |
| | | | | | | | Transversal (Y) | -6.11 | 42.61 | 38.42 | T4 | -48.72 | | |
| 10 | LTE Band 12 | 10 | QPSK | 1 | 0 | 23095 | Axial (Z) | 2.25 | 51.30 | 42.45 | T4 | -49.05 | 2 | Pass |
| | | | | | | | Transversal (Y) | -7.91 | 40.85 | 38.64 | T4 | -48.76 | | |
| 11 | LTE Band 13 | 10 | QPSK | 1 | 0 | 23230 | Axial (Z) | 1.52 | 50.22 | 42.57 | T4 | -48.70 | 2 | Pass |
| | | | | | | | Transversal (Y) | -7.45 | 41.10 | 38.74 | T4 | -48.55 | | |
| 12 | LTE Band 17 | 10 | QPSK | 1 | 0 | 23790 | Axial (Z) | 0.60 | 49.51 | 42.04 | T4 | -48.91 | 2 | Pass |
| | | | | | | | Transversal (Y) | -10.37 | 38.43 | 37.61 | T4 | -48.80 | | |
| 13 | LTE Band 66 | 20 | QPSK | 1 | 0 | 132322 | Axial (Z) | 0.36 | 49.43 | 42.33 | T4 | -49.07 | 2 | Pass |
| | | | | | | | Transversal (Y) | -8.84 | 39.94 | 36.67 | T4 | -48.78 | | |
| 14 | LTE Band 38 | 20 | QPSK | 1 | 0 | 38000 | Axial (Z) | 3.69 | 52.48 | 35.63 | T4 | -48.79 | 1.98 | Pass |
| | | | | | | | Transversal (Y) | -12.87 | 35.82 | 30.20 | T4 | -48.69 | | |

# 9. T-Coil testing for OTT VoIP Calling

**General Notes:**

1. The Google Duo VoIP call software is pre-installed on this device and head-to-ear scenario should be consideration, the Google Duo only support OPUS audio codec and support 6Kbpa to 75Kbps bitrate. According to KDB 285076 D02, all air interfaces via a data connection with google hangouts VoIP calling would be consideration to be tested.
2. The test setup used for Google Duo VoIP call is via the data application unit on CMW500 connection to the Internet, also connection to the other auxiliary VoIP unit which is used to configure the audio codec and bit rate and also monitor the audio input level of -20dBm0.
3. The SIP VoIP application software is pre-installed on this device and head-to-ear scenario should be consideration, the SIP VoIP application support several audio codecs as below table. According to KDB 285076 D02, all air interfaces via a data connection with SIP VoIP calling would be consideration to be tested.
4. The test setup used for SIP VoIP application is via the data application unit on CMW500 connection to the Internet, also connection to the other auxiliary VoIP unit which is used to configure the audio codec and bit rate and can be determined the audio input level of -20dBm0.
5. According to VoLTE radio configuration investigation, the worst case radio configuration is used for OTT over LTE testing.
6. For OTT over WiFi radio configuration investigation is choose either one codec and an investigation was performed on in each data rates and modulations to determine the radio configuration to be used for testing, the following tests results which the worst case configuration would be remarked to be used for the testing for the handset.
7. For OTT VoIP codec investigation test reduction, due to all air interface have the same codec configuration, therefore, the codec investigation was choose UMTS Band 2 to determine the audio codec configuration to be used for others air interfaces testing.

## 9.1 OTT over GSM

**<Google Duo Codec Investigation>**

| Codec | Bitrate 6Kbps | Bitrate 40Kbps | Bitrate 75Kbps | Orientation | Band / Channel |
|---|---|---|---|---|---|
| ABM 1 (dBA/m) | 0.46 | 0.89 | 0.4 | Axial | UMTS B2 / 9400 |
| ABM 2 (dBA/m) | -35.96 | -35.03 | -35.3 | | |
| Signal Quality (dB) | 36.42 | 35.92 | 35.7 | | |
| Freq. Response | PASS | PASS | PASS | | |

**<SIP Codec Investigation>**

| VoIP Codec(SIP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Codec | GSM 8 kHz | GSM -EFR | AMR 8 kHz | G.711 A-law | G.711 u-law | Orientation | Band / Channel |
| ABM 1 (dBA/m) | -1.87 | -2.88 | -2.71 | -0.41 | -1.7 | Axial | UMTS B2 / 9400 |
| ABM 2 (dBA/m) | -36.23 | -37.32 | -37.44 | -35.32 | -35.81 | | |
| Signal Quality (dB) | 34.36 | 34.44 | 34.73 | 34.91 | 34.11 | | |
| Freq. Response | PASS | PASS | PASS | PASS | PASS | | |

## <Radio Configuration Investigation>

| Air Interface | Bandwidth (MHz) | Data Rate | channel | ABM1 dB (A/m) | ABM2 dB (A/m) | Signal Quality (dB) |
|---|---|---|---|---|---|---|
| WLAN2.4GHz | 802.11b | 1Mbps | 6 | -1.70 | -33.14 | 31.44 |
| WLAN2.4GHz | 802.11b | 11Mbps | 6 | -1.21 | -33.70 | 32.49 |
| WLAN2.4GHz | 802.11g | 6Mbps | 6 | -1.73 | -33.64 | 31.91 |
| WLAN2.4GHz | 802.11g | 54Mbps | 6 | -1.94 | -33.63 | 31.69 |
| WLAN2.4GHz | 802.11n-HT20 | MCS0 | 6 | -1.78 | -33.42 | 31.64 |
| WLAN2.4GHz | 802.11n-HT20 | MCS7 | 6 | -1.38 | -33.19 | 31.81 |
| WLAN2.4GHz | 802.11n-HT40 | MCS0 | 6 | -1.65 | -33.23 | 31.58 |
| WLAN2.4GHz | 802.11n-HT40 | MCS7 | 6 | -1.15 | -33.14 | 31.99 |

## <Summary Tests Results>

| Plot No. | Air Interface | Mode | Channel | Probe Position | ABM1 dB (A/m) | ABM2 dB (A/m) | Signal Quality dB | T Rating | Ambient Noise dB (A/m) | Freq. Response Variation dB | Frequency Response |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | GSM850 | EDGE 2 Tx slots | 189 | Axial (Z) | -1.65 | -25.29 | 23.64 | T3 | -50.28 | 2 | Pass |
| | | | | Transversal (Y) | -10.02 | -34.61 | 24.59 | T3 | -50.18 | | |
| 16 | GSM1900 | EDGE 2 Tx slots | 661 | Axial (Z) | -2.19 | -26.00 | 23.81 | T3 | -50.30 | 2 | Pass |
| | | | | Transversal (Y) | -10.18 | -34.82 | 24.64 | T3 | -50.21 | | |
| 17 | WCDMA II | HSPA | 9400 | Axial (Z) | -1.70 | -35.81 | 34.11 | T4 | -50.33 | 2 | Pass |
| | | | | Transversal (Y) | -11.22 | -43.97 | 32.75 | T4 | -50.22 | | |
| 18 | WCDMA IV | HSPA | 1413 | Axial (Z) | -4.42 | -36.42 | 32.00 | T4 | -50.35 | 2 | Pass |
| | | | | Transversal (Y) | -11.91 | -43.69 | 31.78 | T4 | -50.25 | | |
| 19 | WCDMA V | HSPA | 4182 | Axial (Z) | -2.92 | -37.12 | 34.20 | T4 | -50.29 | 1.89 | Pass |
| | | | | Transversal (Y) | -9.53 | -43.12 | 33.59 | T4 | -50.18 | | |
| 20 | LTE Band 66 | 20M_QPSK_1_0 | 132322 | Axial (Z) | -2.54 | -33.73 | 31.19 | T4 | -50.25 | 2 | Pass |
| | | | | Transversal (Y) | -9.15 | -40.14 | 30.99 | T4 | -50.15 | | |
| 21 | LTE Band 38 | 20M_ QPSK_1_0 | 38000 | Axial (Z) | -2.02 | -29.18 | 27.16 | T3 | -50.36 | 1.86 | Pass |
| | | | | Transversal (Y) | -8.95 | -32.16 | 23.21 | T3 | -50.24 | | |
| 22 | WLAN2.4GHz | 802.11b 1Mbps | 6 | Axial (Z) | -1.57 | -34.11 | 32.54 | T4 | -50.36 | 2 | Pass |
| | | | | Transversal (Y) | -10.26 | -37.93 | 27.67 | T3 | -50.22 | | |

**Remark:**

1. Phone Condition: Mute on; Backlight off; Max Volume
2. The detail frequency response results please refer to appendix A.
3. Test Engineer: Tom Jiang Galen Chang Iran Wang and Steven Chang

# 10. Uncertainty Assessment

The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance. The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual “root-sum-squares” (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances. Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is showed in Table 8.2.

| Error Description | Uncertainty Value (±%) | Probability Distribution | Divisor | Ci (ABM1) | Ci (ABM2) | Standard Uncertainty (ABM1) | Standard Uncertainty (ABM2) |
|---|---|---|---|---|---|---|---|
| Probe Sensitivity | | | | | | | |
| Reference Level | 3.0 | Normal | 1 | 1 | 1 | ± 3.0 % | ± 3.0 % |
| AMCC Geometry | 0.4 | Rectangular | √3 | 1 | 1 | ± 0.2 % | ± 0.2 % |
| AMCC Current | 1.0 | Rectangular | √3 | 1 | 1 | ± 0.6 % | ± 0.6 % |
| Probe Positioning During Calibrate | 0.1 | Rectangular | √3 | 1 | 1 | ± 0.1 % | ± 0.1 % |
| Noise Contribution | 0.7 | Rectangular | √3 | 0.0143 | 1 | ± 0.0 % | ± 0.4 % |
| Frequency Slope | 5.9 | Rectangular | √3 | 0.1 | 1 | ± 0.3 % | ± 3.5 % |
| Probe System | | | | | | | |
| Repeatability / Drift | 1.0 | Rectangular | √3 | 1 | 1 | ± 0.6 % | ± 0.6 % |
| Linearity / Dynamic Range | 0.6 | Rectangular | √3 | 1 | 1 | ± 0.4 % | ± 0.4 % |
| Acoustic Noise | 1.0 | Rectangular | √3 | 0.1 | 1 | ± 0.1 % | ± 0.6 % |
| Probe Angle | 2.3 | Rectangular | √3 | 1 | 1 | ± 1.4 % | ± 1.4 % |
| Spectral Processing | 0.9 | Rectangular | √3 | 1 | 1 | ± 0.5 % | ± 0.5 % |
| Integration Time | 0.6 | Normal | 1 | 1 | 5 | ± 0.6 % | ± 3.0 % |
| Field Disturbation | 0.2 | Rectangular | √3 | 1 | 1 | ± 0.1 % | ± 0.1 % |
| Test Signal | | | | | | | |
| Reference Signal Spectral Response | 0.6 | Rectangular | √3 | 0 | 1 | ± 0.0 % | ± 0.4 % |
| Positioning | | | | | | | |
| Probe Positioning | 1.9 | Rectangular | √3 | 1 | 1 | ± 1.1 % | ± 1.1 % |
| Phantom Thickness | 0.9 | Rectangular | √3 | 1 | 1 | ± 0.5 % | ± 0.5 % |
| EUT Positioning | 1.9 | Rectangular | √3 | 1 | 1 | ± 1.1 % | ± 1.1 % |
| External Contributions | | | | | | | |
| RF Interference | 0.0 | Rectangular | √3 | 1 | 0.3 | ± 0.0 % | ± 0.0 % |
| Test Signal Variation | 2.0 | Rectangular | √3 | 1 | 1 | ± 1.2 % | ± 1.2 % |
| Combined Standard Uncertainty | | | | | | ± 4.1 % | ± 6.1 % |
| Coverage Factor for 95 % | | | | | | K = 2 | |
| Expanded Uncertainty | | | | | | ± 8.1 % | ± 12.3 % |

**Table 8.2 Uncertainty Budget of audio band magnetic measurement**

# 11. References


[1] ANSI C63.19-2011, “American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids”, 27 May 2011.

[2] FCC KDB 285076 D01v05, “Equipment Authorization Guidance for Hearing Aid Compatibility”, Sep 2017

[3] FCC KDB 285076 D02v03, “Guidance for performing T-Coil tests for air interfaces supporting voice over IP (e.g., LTE and WiFi) to support CMRS based telephone services”, Sep 2017

[4] FCC KDB 285076 D03v01, “Hearing aid compatibility frequently asked questions”, Sep 2017

[5] SPEAG DASY System Handbook

## Appendix A. Plots of T-Coil Measurement

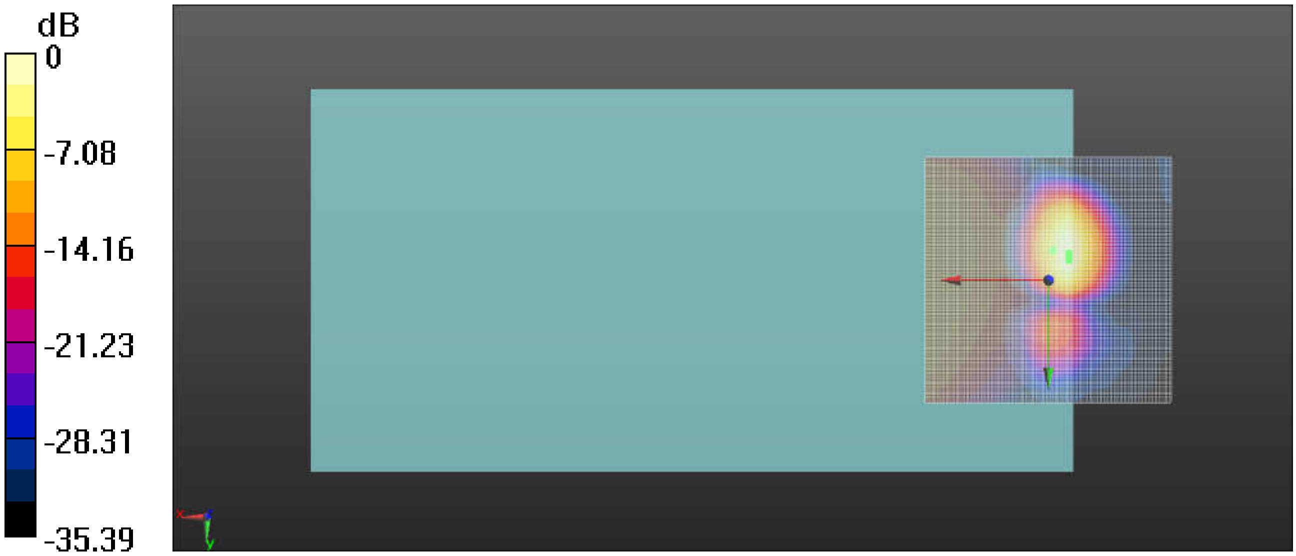
The plots are shown as follows.

## 01_HAC T-Coil_GSM850_Voice_Ch189_Z

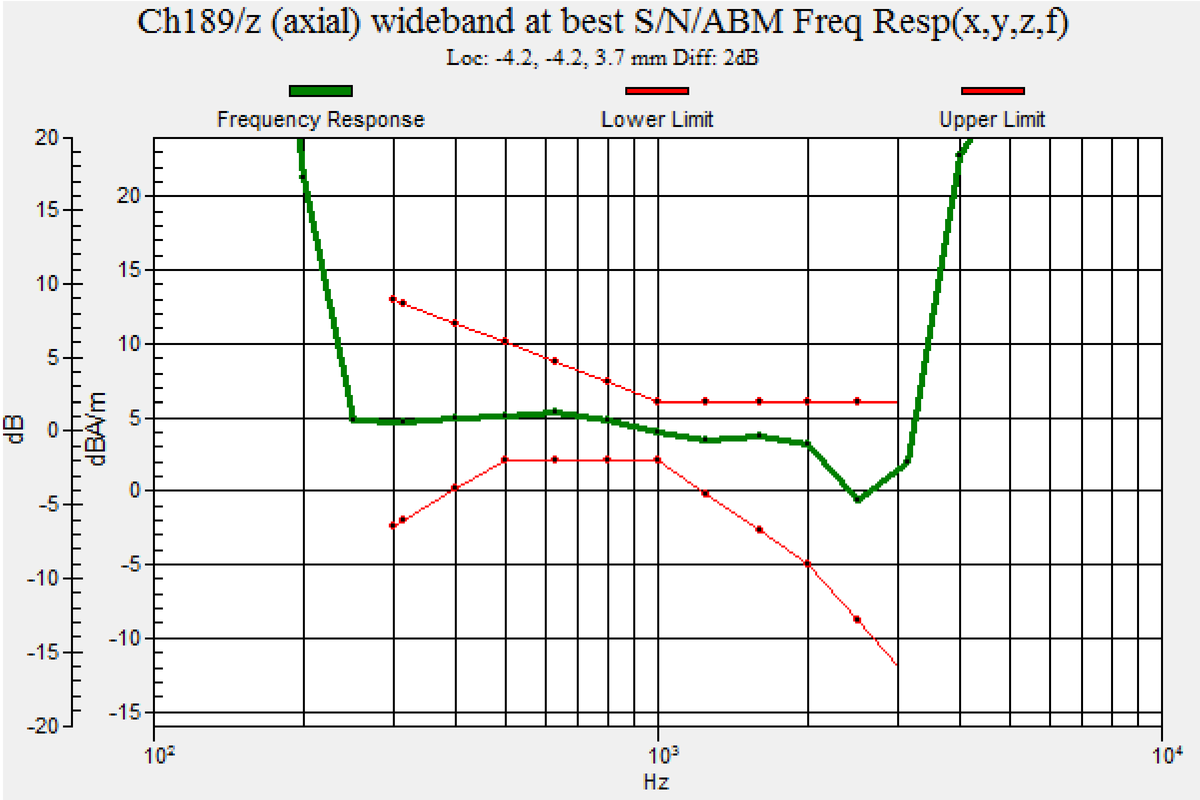
Communication System: UID 0, Generic GSM (0); Frequency: 836.4 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3106; ; Calibrated: 2017.11.28
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1386; Calibrated: 2017.07.20
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch189/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):** Interpolated grid: dx=10mm, dy=10mm
ABM1/ABM2 = 24.74 dB
ABM1 comp = 4.00 dBA/m
BWC Factor = 0.16 dB
Location: -4.2, -5.4, 3.7 mm




0 dB = 1.831 A/m = 5.25 dBA/m



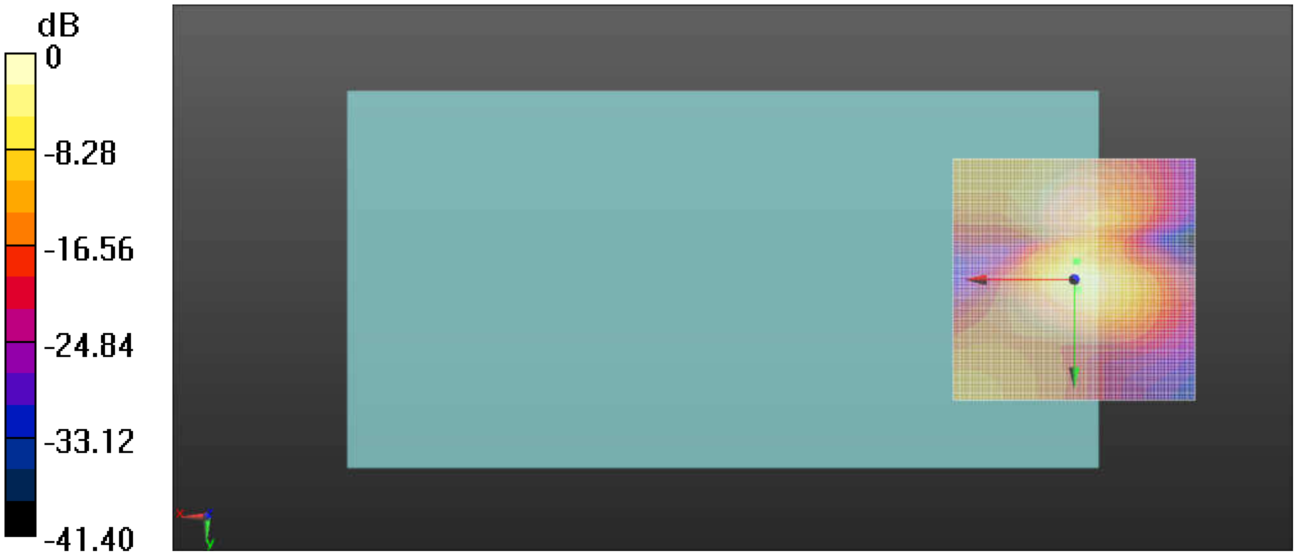
Ch189/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4.2, -4.2, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

## 01_HAC T-Coil_GSM850_Voice_Ch189_Y

Communication System: UID 0, Generic GSM (0); Frequency: 836.4 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3106; ; Calibrated: 2017.11.28
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1386; Calibrated: 2017.07.20
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch189/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=10mm, dy=10mm
ABM1/ABM2 = 26.55 dB
ABM1 comp = -10.05 dBA/m
BWC Factor = 0.16 dB
Location: -0.4, -3.8, 3.7 mm



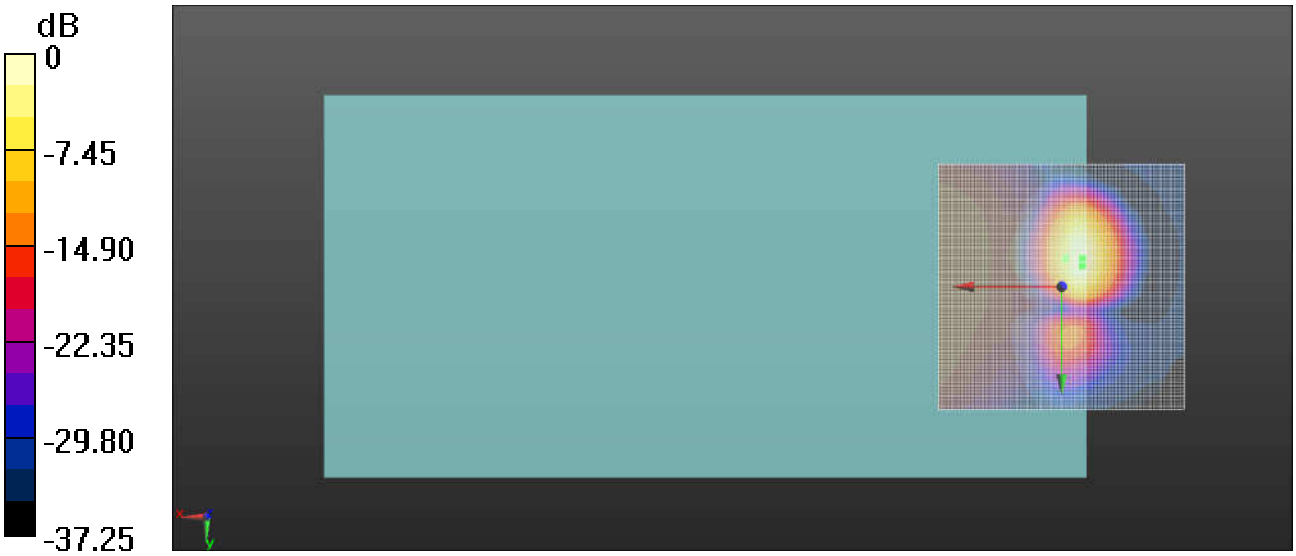

0 dB = 0.8431 A/m = -1.48 dBA/m

## 02_HAC T-Coil_GSM1900_Voice_Ch661_Z

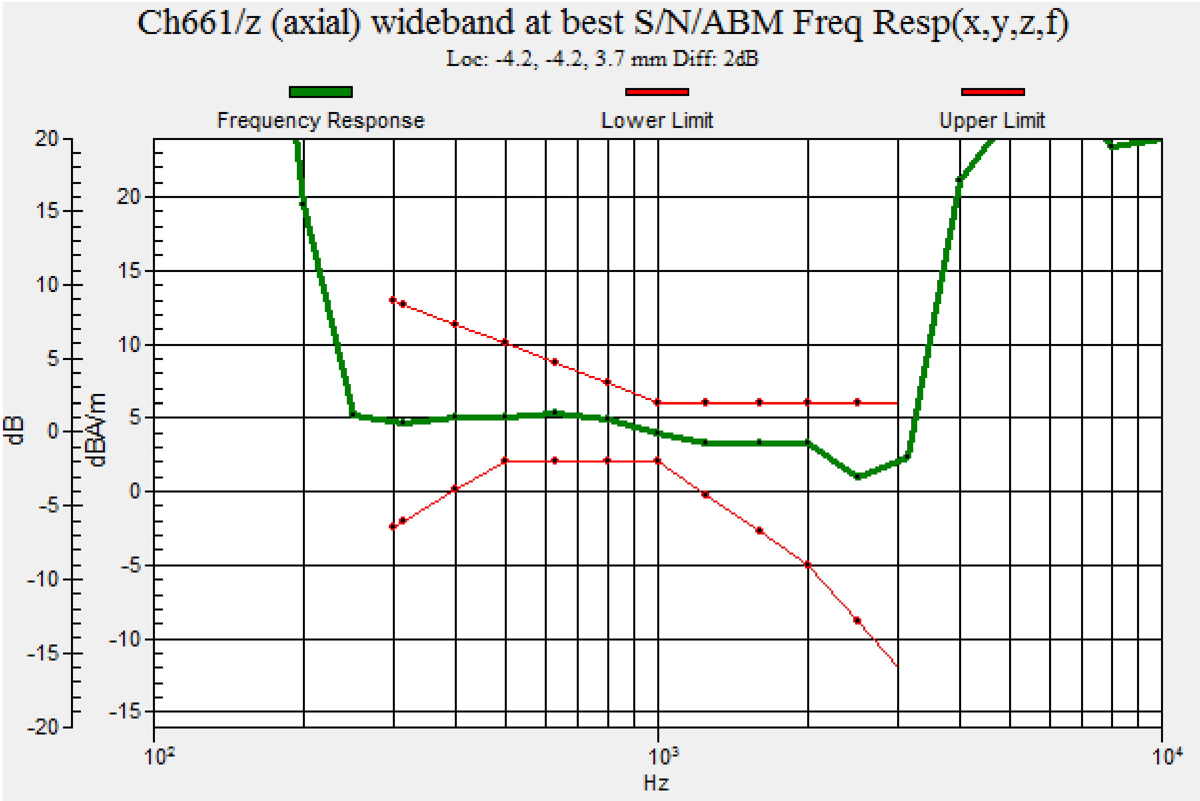
Communication System: UID 0, Generic GSM (0); Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3106; ; Calibrated: 2017.11.28
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1386; Calibrated: 2017.07.20
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch661/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):** Interpolated grid: dx=10mm, dy=10mm
ABM1/ABM2 = 27.39 dB
ABM1 comp = 4.13 dBA/m
BWC Factor = 0.16 dB
Location: -4.2, -5.8, 3.7 mm




0 dB = 1.845 A/m = 5.32 dBA/m


Ch661/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4.2, -4.2, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

## 02_HAC T-Coil_GSM1900_Voice_Ch661_Y

Communication System: UID 0, Generic GSM (0); Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3106; ; Calibrated: 2017.11.28
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1386; Calibrated: 2017.07.20
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch661/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=10mm, dy=10mm
ABM1/ABM2 = 29.41 dB
ABM1 comp = -9.64 dBA/m
BWC Factor = 0.16 dB
Location: -0.8, -3.8, 3.7 mm


0 dB = 0.8508 A/m = -1.40 dBA/m

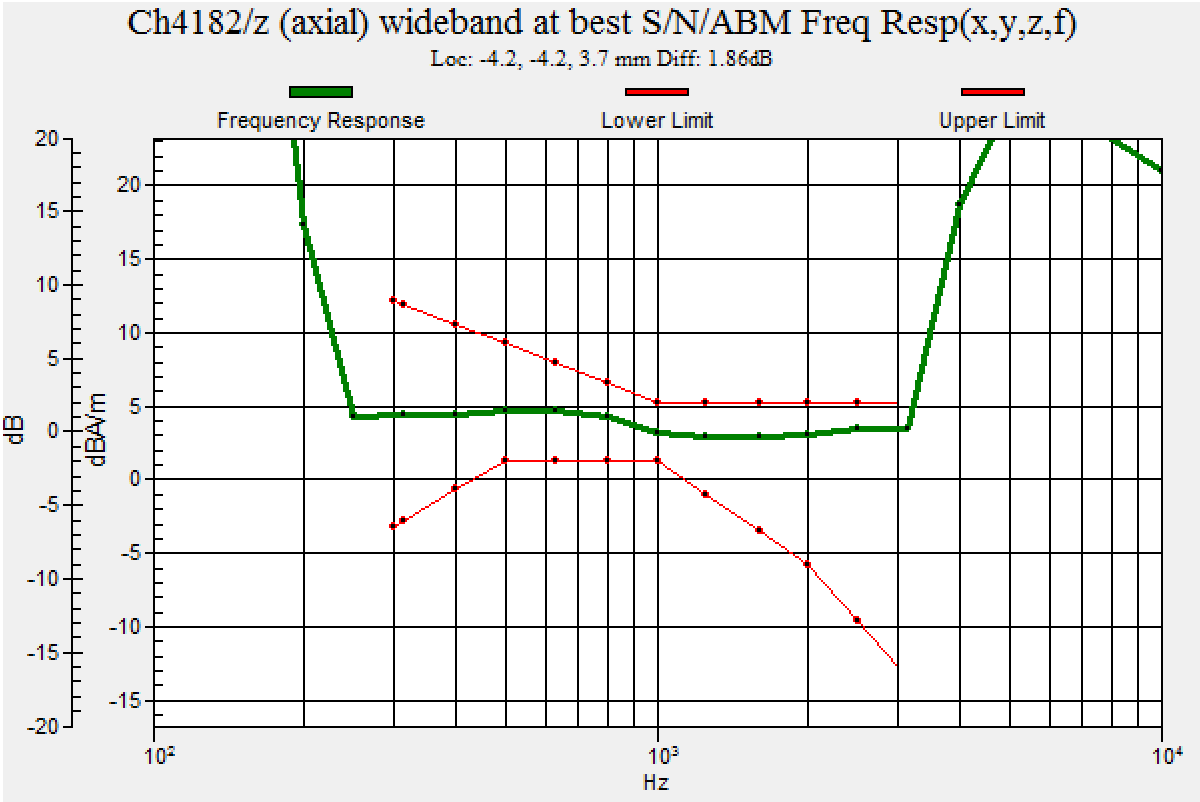
## 03_HAC T-Coil_WCDMA V_AMR_12.2Kbps_Ch4182_Z

Communication System: UID 0, UMTS (0); Frequency: 836.4 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3106; ; Calibrated: 2017.11.28
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1386; Calibrated: 2017.07.20
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch4182/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=10mm, dy=10mm
ABM1/ABM2 = 45.31 dB
ABM1 comp = 2.49 dBA/m
BWC Factor = 0.16 dB
Location: -5.8, -5, 3.7 mm


0 dB = 1.876 A/m = 5.46 dBA/m



Ch4182/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4.2, -4.2, 3.7 mm Diff: 1.86dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

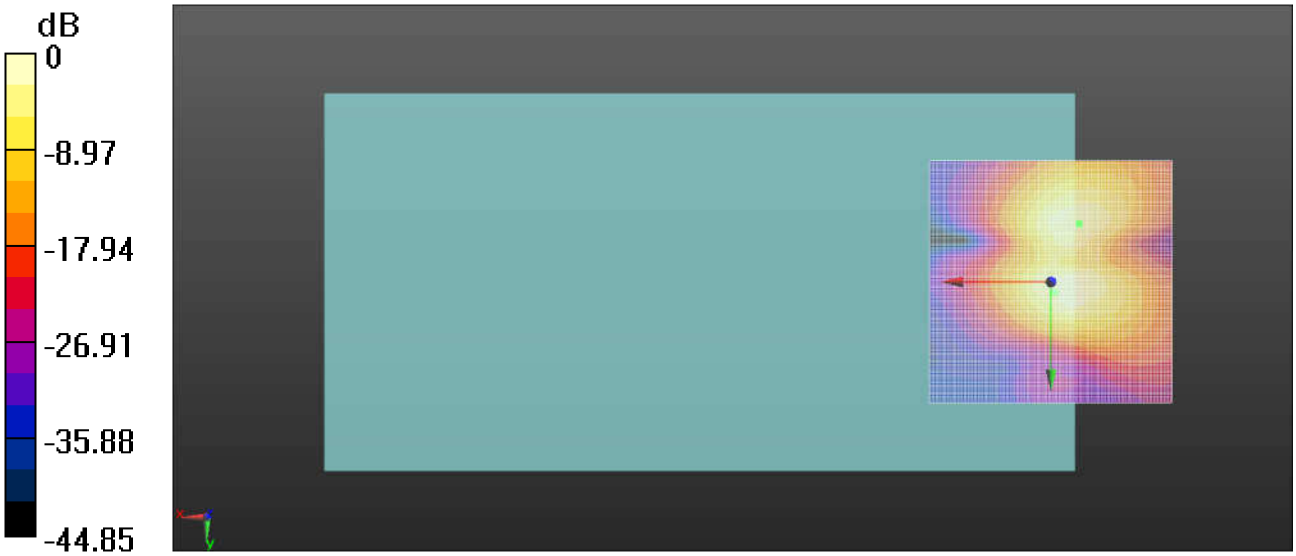
Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.05.17

## 03_HAC T-Coil_WCDMA V_AMR_12.2Kbps_Ch4182_Y

Communication System: UID 0, UMTS (0); Frequency: 836.4 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3106; ; Calibrated: 2017.11.28
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1386; Calibrated: 2017.07.20
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

### Ch4182/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):
Interpolated grid: dx=10mm, dy=10mm
ABM1/ABM2 = 42.26 dB
ABM1 comp = -5.77 dBA/m
BWC Factor = 0.16 dB
Location: -5.8, -12.1, 3.7 mm



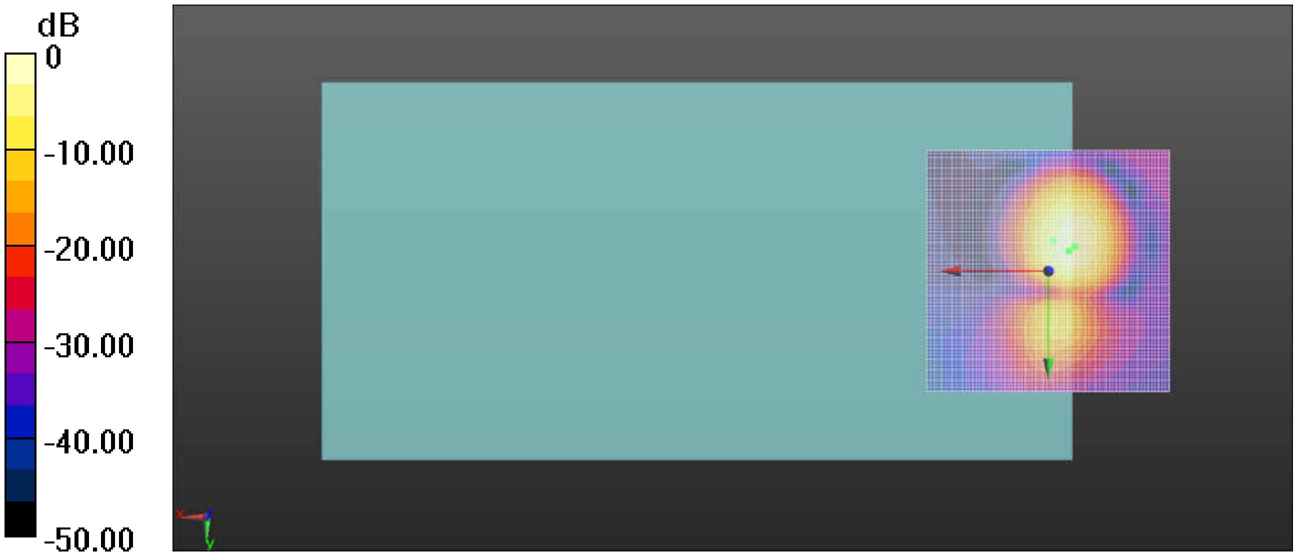

0 dB = 0.8728 A/m = -1.18 dBA/m

## 04_HAC T-Coil_WCDMA IV_AMR_12.2Kbps_Ch1413_Z

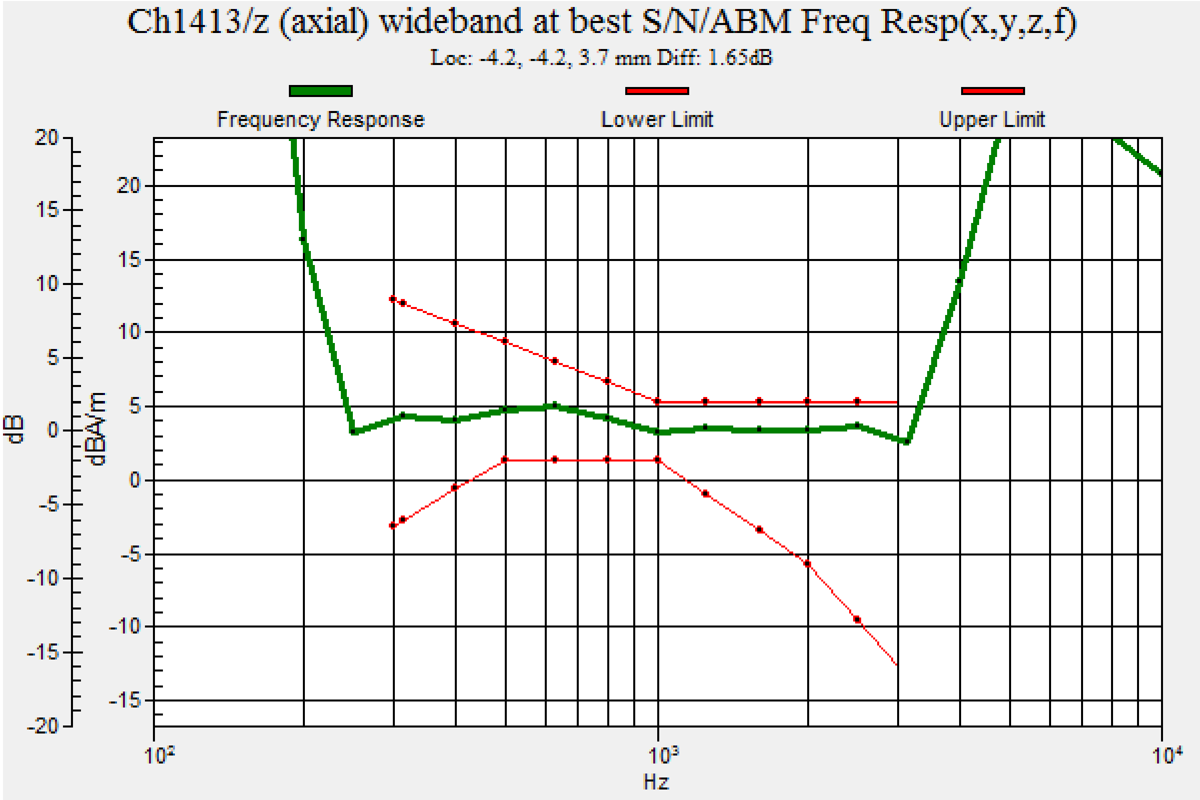
Communication System: UID 0, UMTS (0); Frequency: 1732.6 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3106; ; Calibrated: 2017.11.28
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1386; Calibrated: 2017.07.20
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch1413/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=10mm, dy=10mm
ABM1/ABM2 = 44.88 dB
ABM1 comp = 2.91 dBA/m
BWC Factor = 0.16 dB
Location: -5.4, -5, 3.7 mm




0 dB = 1.828 A/m = 5.24 dBA/m



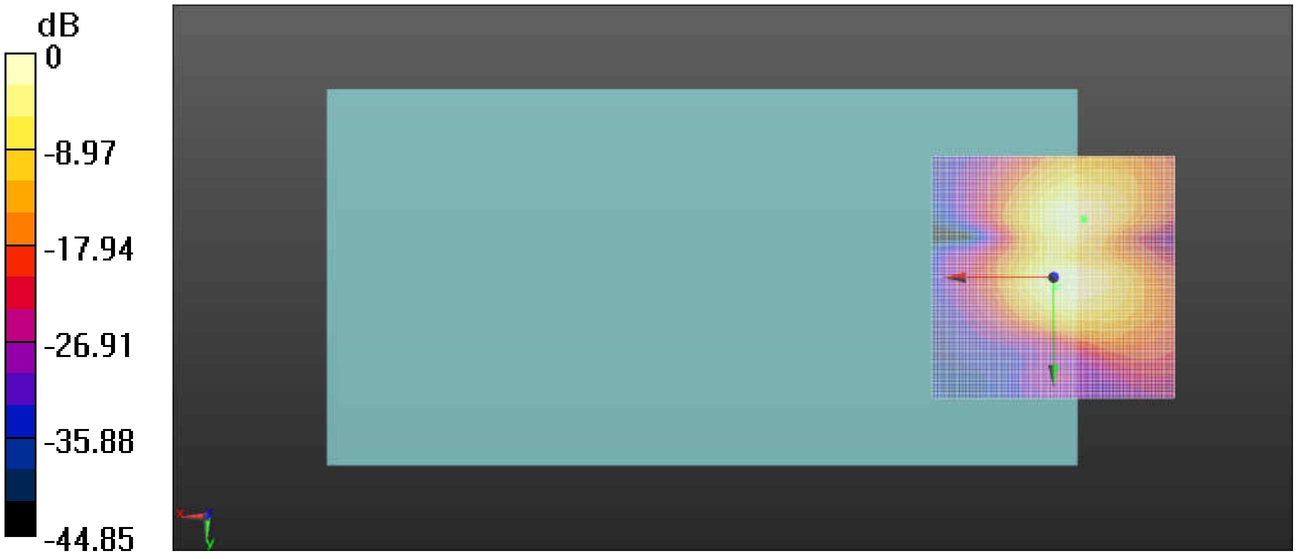
Ch1413/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4.2, -4.2, 3.7 mm Diff: 1.65dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

## 04_HAC T-Coil_WCDMA IV_AMR_12.2Kbps_Ch1413_Y

Communication System: UID 0, UMTS (0); Frequency: 1732.6 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3106; ; Calibrated: 2017.11.28
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1386; Calibrated: 2017.07.20
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch1413/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=10mm, dy=10mm
ABM1/ABM2 = 41.76 dB
ABM1 comp = -6.17 dBA/m
BWC Factor = 0.16 dB
Location: -6.2, -12.1, 3.7 mm




0 dB = 0.8699 A/m = -1.21 dBA/m

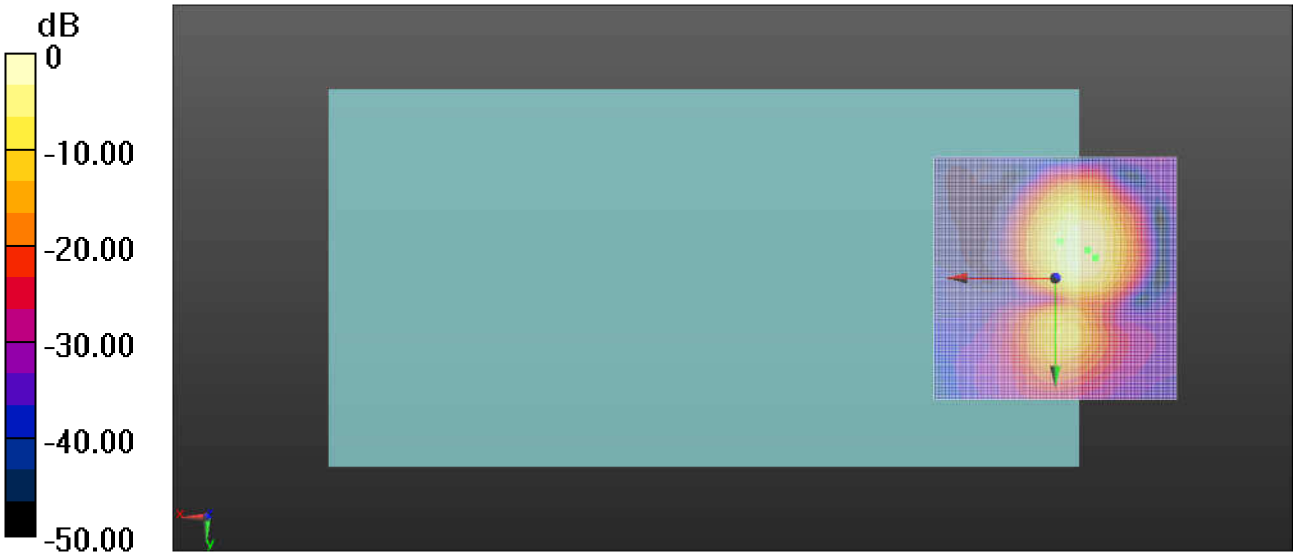
## 05_HAC T-Coil_WCDMA II_AMR_12.2Kbps_Ch9400_Z

Communication System: UID 0, UMTS (0); Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.4 ℃

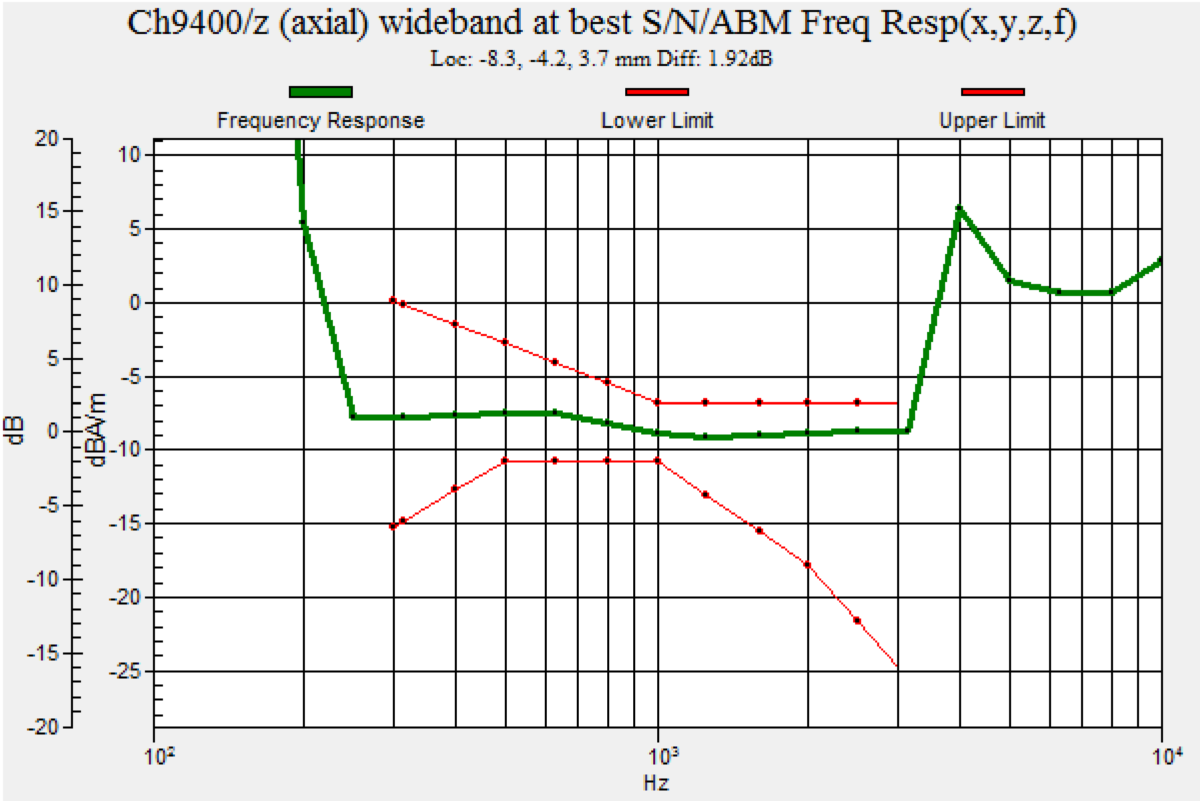
DASY5 Configuration:
- Probe: AM1DV3 - 3106; ; Calibrated: 2017.11.28
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1386; Calibrated: 2017.07.20
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

### Ch9400/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):

Interpolated grid: dx=10mm, dy=10mm
ABM1/ABM2 = 37.78 dB
ABM1 comp = -5.32 dBA/m
BWC Factor = 0.16 dB
Location: -6.7, -5.8, 3.7 mm




0 dB = 0.8166 A/m = -1.76 dBA/m



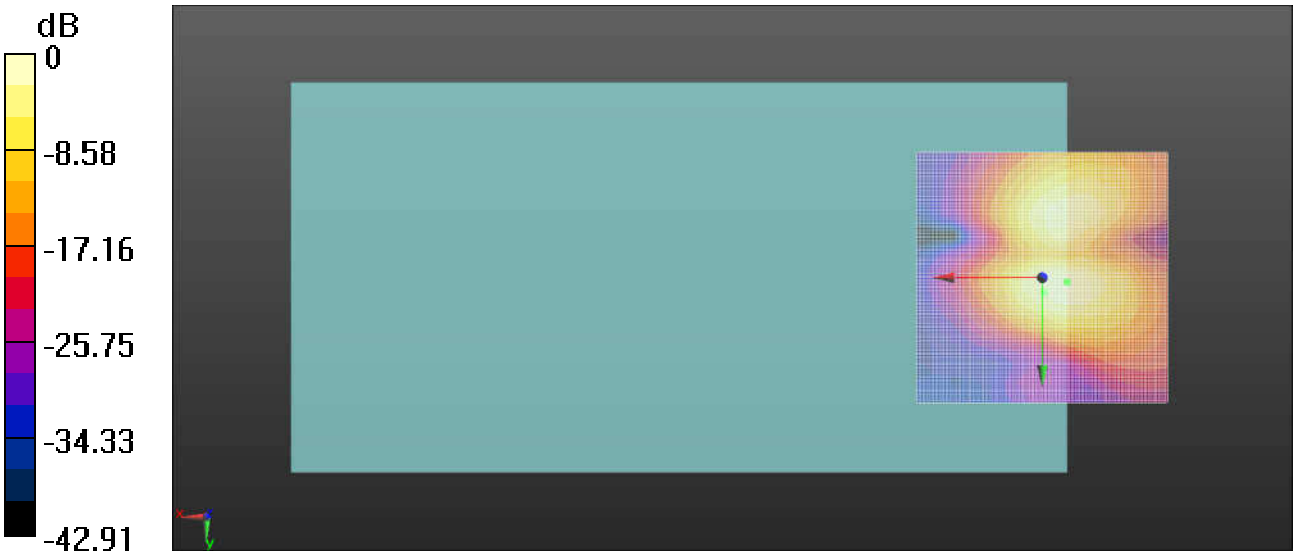
Ch9400/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -8.3, -4.2, 3.7 mm Diff: 1.92dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

## 05_HAC T-Coil_WCDMA II_AMR_12.2Kbps_Ch9400_Y

Communication System: UID 0, UMTS (0); Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3106; ; Calibrated: 2017.11.28
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1386; Calibrated: 2017.07.20
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch9400/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=10mm, dy=10mm
ABM1/ABM2 = 34.38 dB
ABM1 comp = -10.02 dBA/m
BWC Factor = 0.16 dB
Location: -5, 0.8, 3.7 mm




0 dB = 0.4110 A/m = -7.72 dBA/m

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.6.2

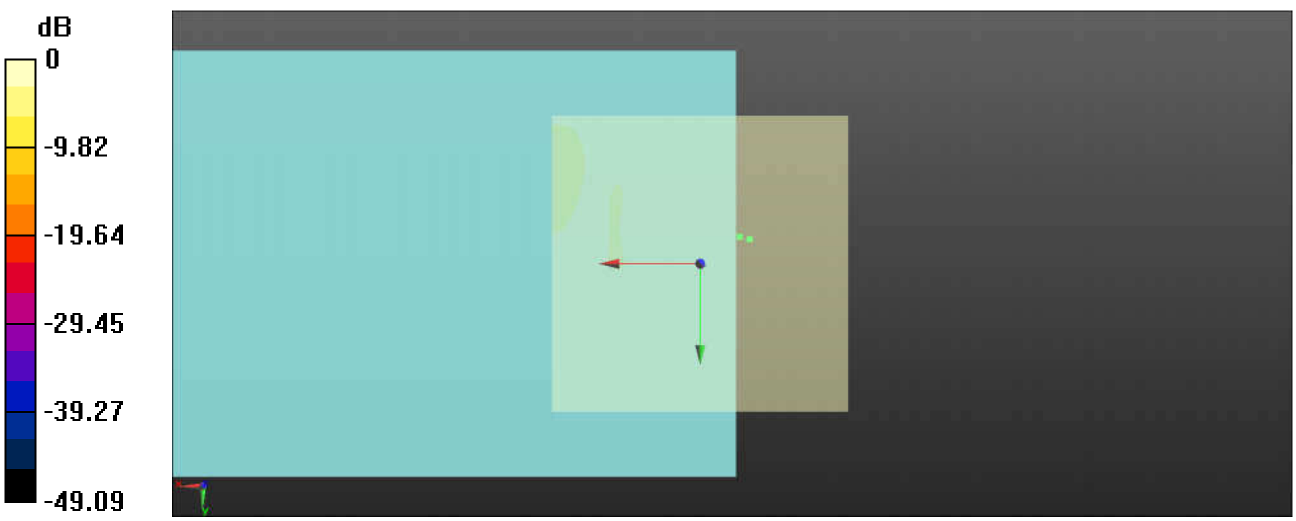
**06_HAC_T-Coil_LTE Band 2_20M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch18900(Z)**

Communication System: UID 0, FDD_LTE (0); Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

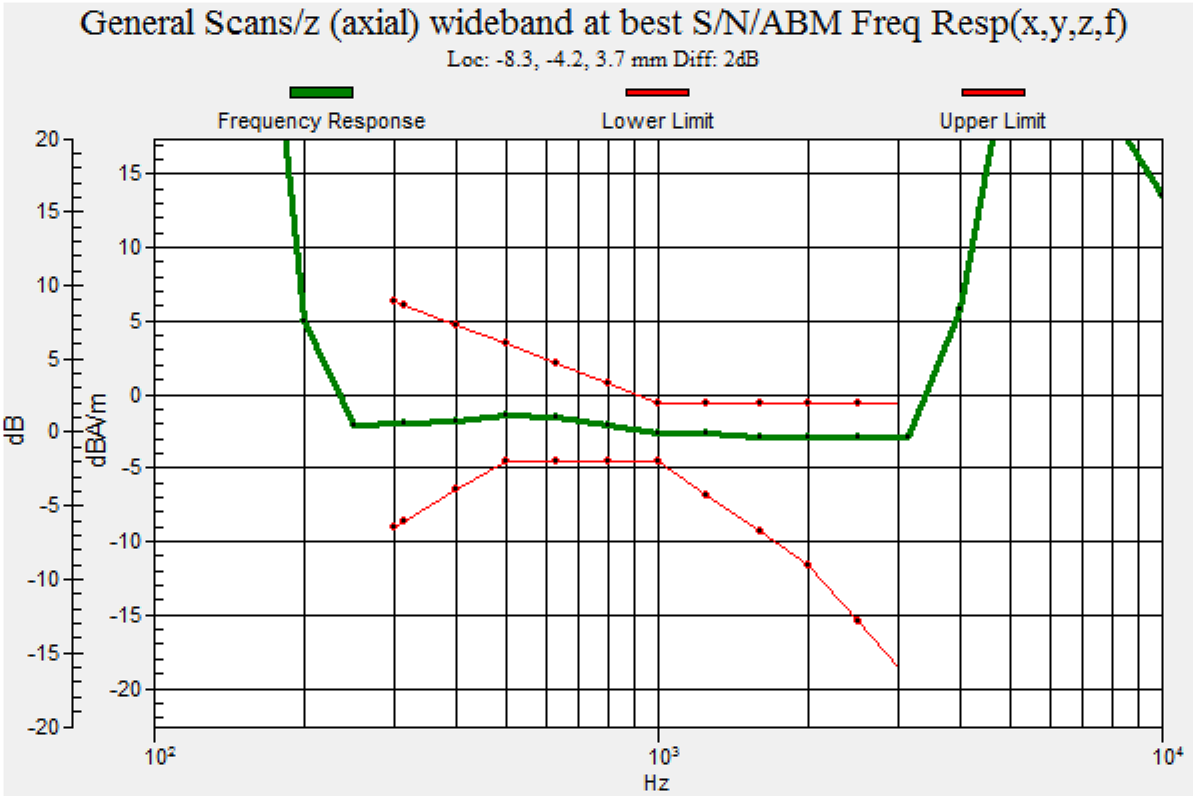
DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

## General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):

Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 42.77 dB
ABM1 comp = 0.64 dBA/m
Location: -6.7, -4.6, 3.7 mm




0 dB = 1.000 = 0.00 dB



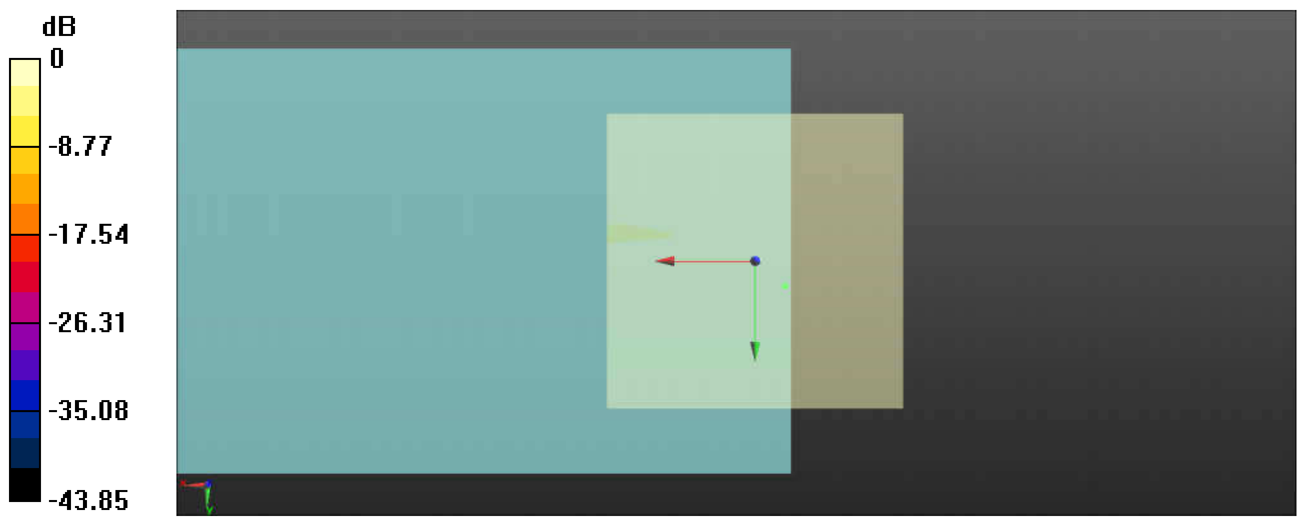
General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -8.3, -4.2, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

**06_HAC_T-Coil_LTE Band 2_20M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch18900(Y)**

Communication System: UID 0, FDD_LTE (0); Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- 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)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 38.28 dB
ABM1 comp = -5.57 dBA/m
Location: -5, 4.2, 3.7 mm




0 dB = 1.000 = 0.00 dB

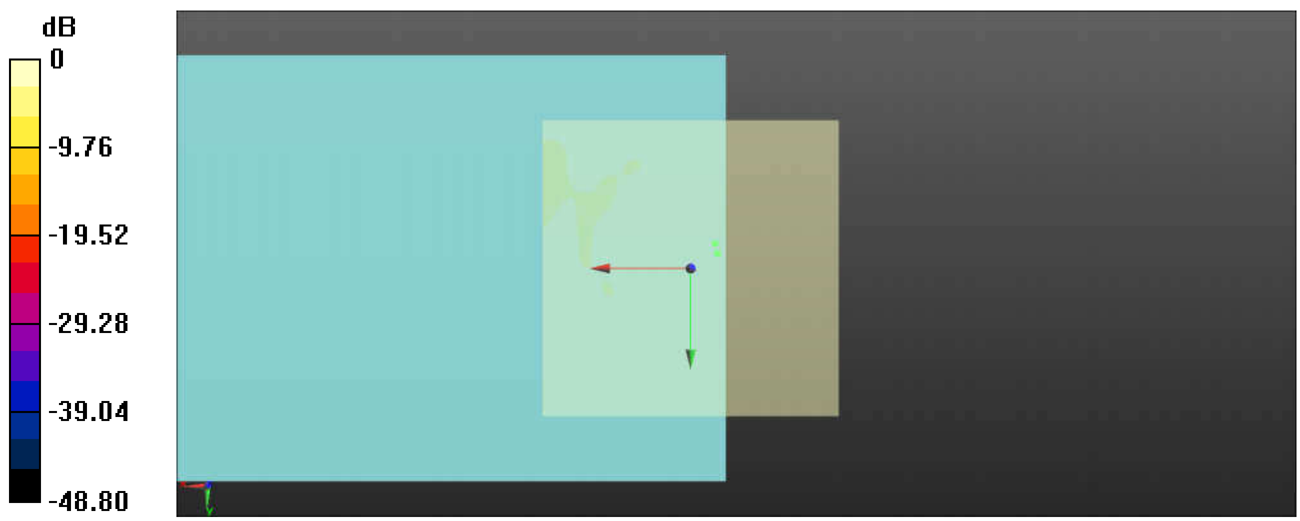
**07_HAC_T-Coil_LTE Band 4_20M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch20175(Z)**

Communication System: UID 0, FDD_LTE (0); Frequency: 1745 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

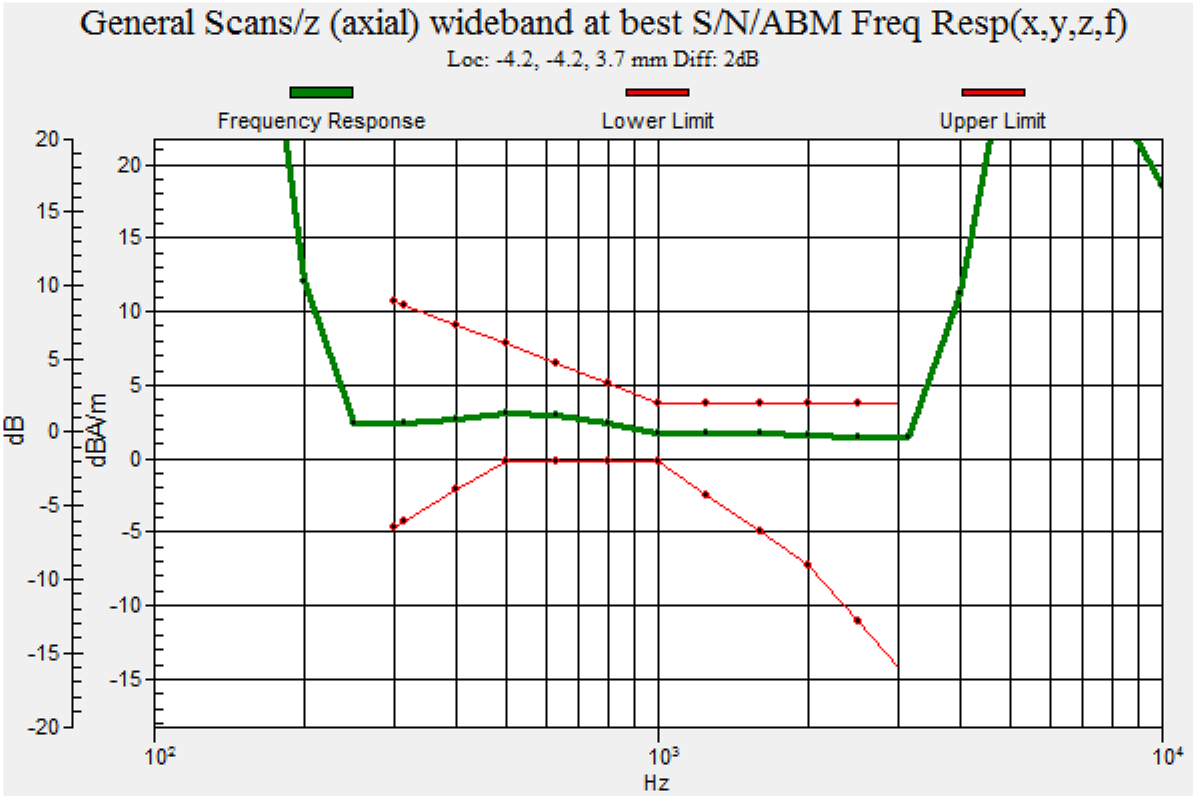
DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

## General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):

Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 42.76 dB
ABM1 comp = 1.09 dBA/m
Location: -4.6, -2.5, 3.7 mm




0 dB = 1.000 = 0.00 dB

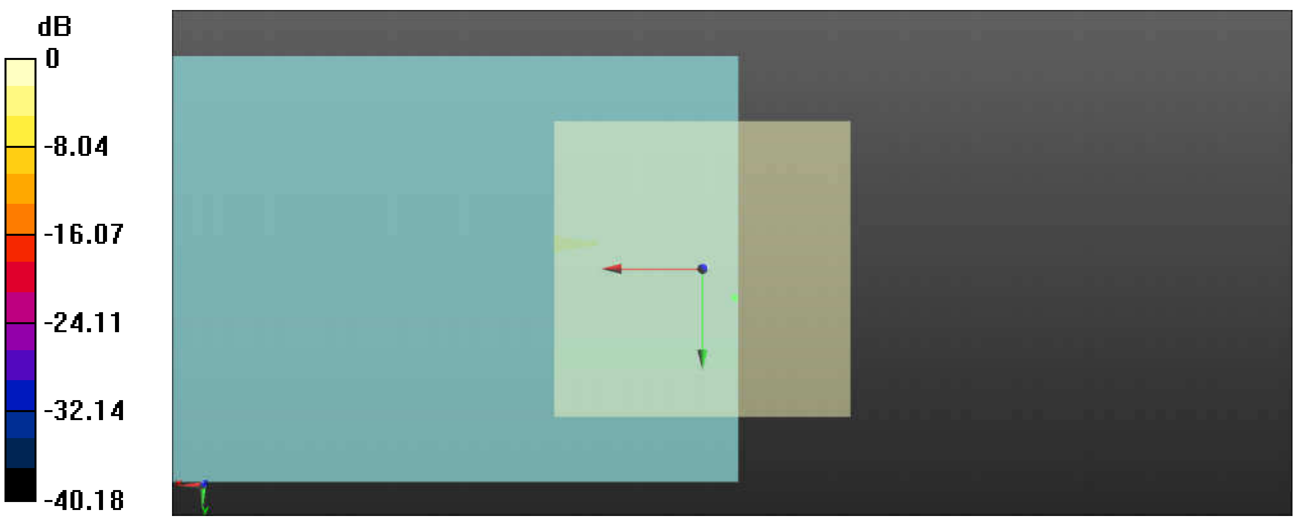

General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4.2, -4.2, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz
20
15
10
5
0
-5
-10
-15
-20
$10^2$
$10^3$
$10^4$

**07_HAC_T-Coil_LTE Band 4_20M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch20175(Y)**

Communication System: UID 0, FDD_LTE (0); Frequency: 1745 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- 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)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 36.86 dB
ABM1 comp = -8.02 dBA/m
Location: -5.4, 5, 3.7 mm




0 dB = 1.000 = 0.00 dB

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.6.2

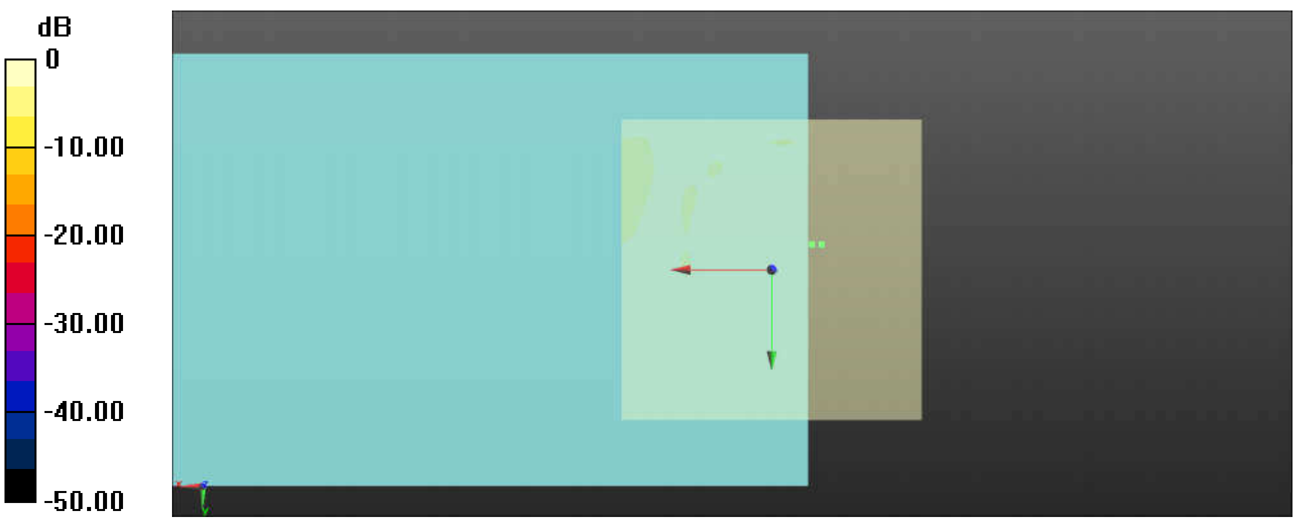
**08_HAC_T-Coil_LTE Band 5_10M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch20525(Z)**

Communication System: UID 0, FDD_LTE (0); Frequency: 836.5 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

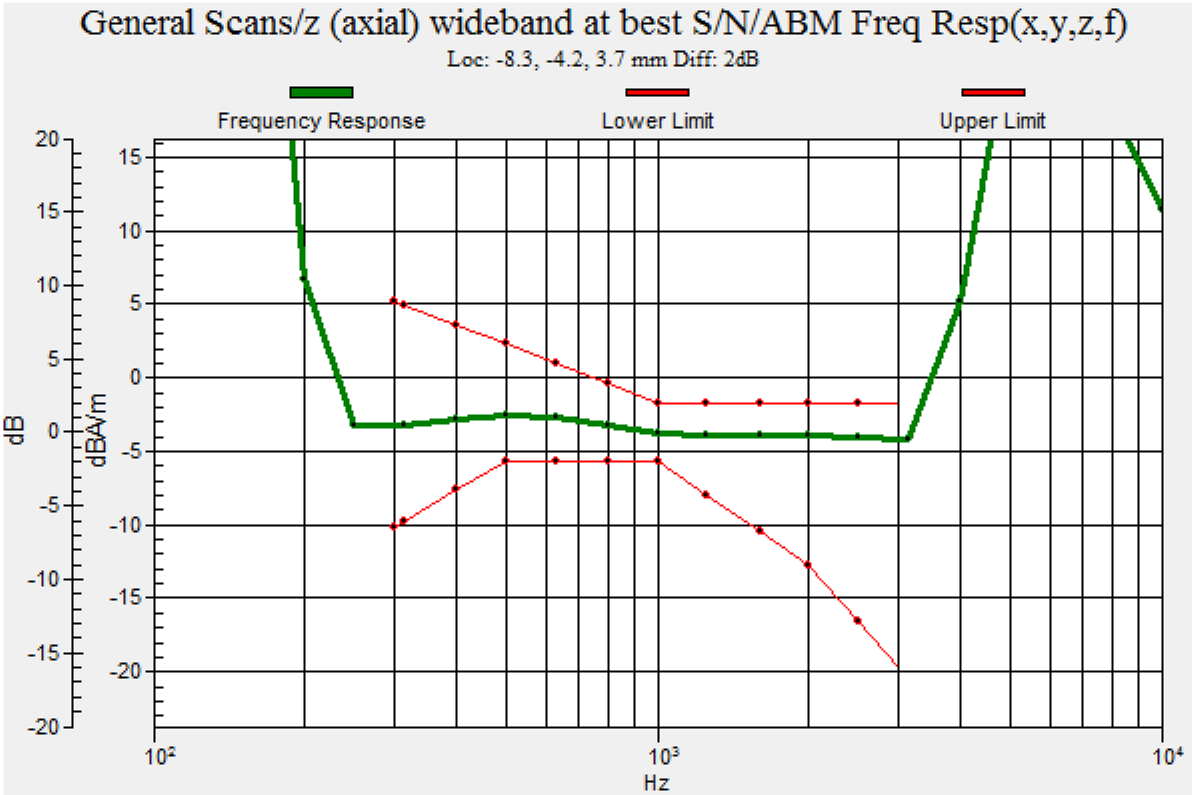
DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

## General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):

Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 43.45 dB
ABM1 comp = -0.05 dBA/m
Location: -6.7, -4.2, 3.7 mm




0 dB = 1.000 = 0.00 dB

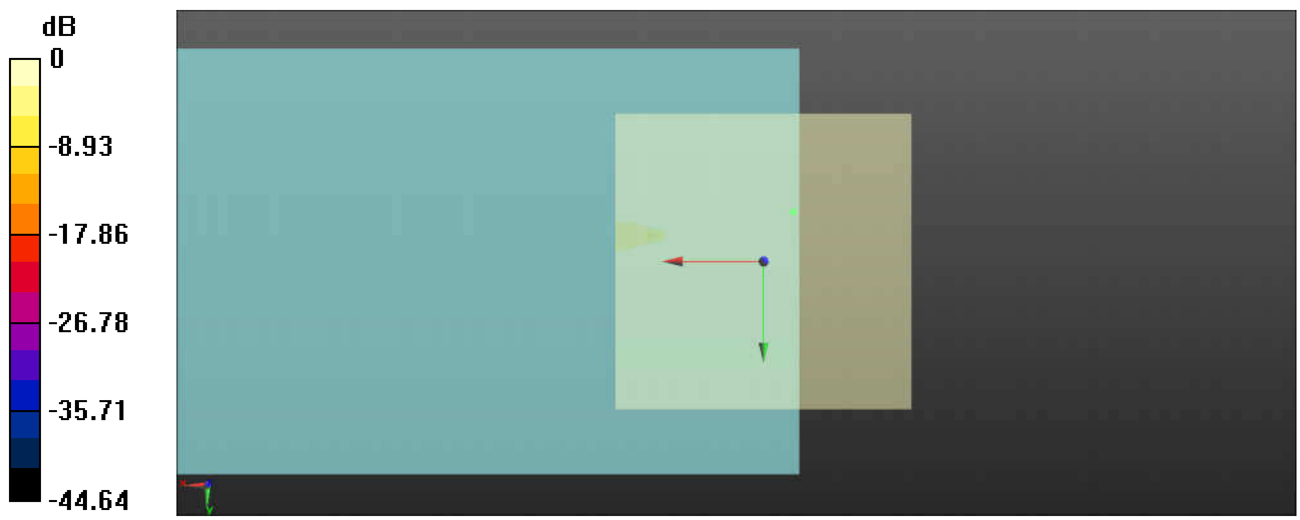

General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -8.3, -4.2, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz
20
15
10
5
0
-5
-10
-15
-20
10²
10³
10⁴

**08_HAC_T-Coil_LTE Band 5_10M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch20525(Y)**

Communication System: UID 0, FDD_LTE (0); Frequency: 836.5 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- 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)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 38.61 dB
ABM1 comp = -8.45 dBA/m
Location: -5, -8.3, 3.7 mm




0 dB = 1.000 = 0.00 dB

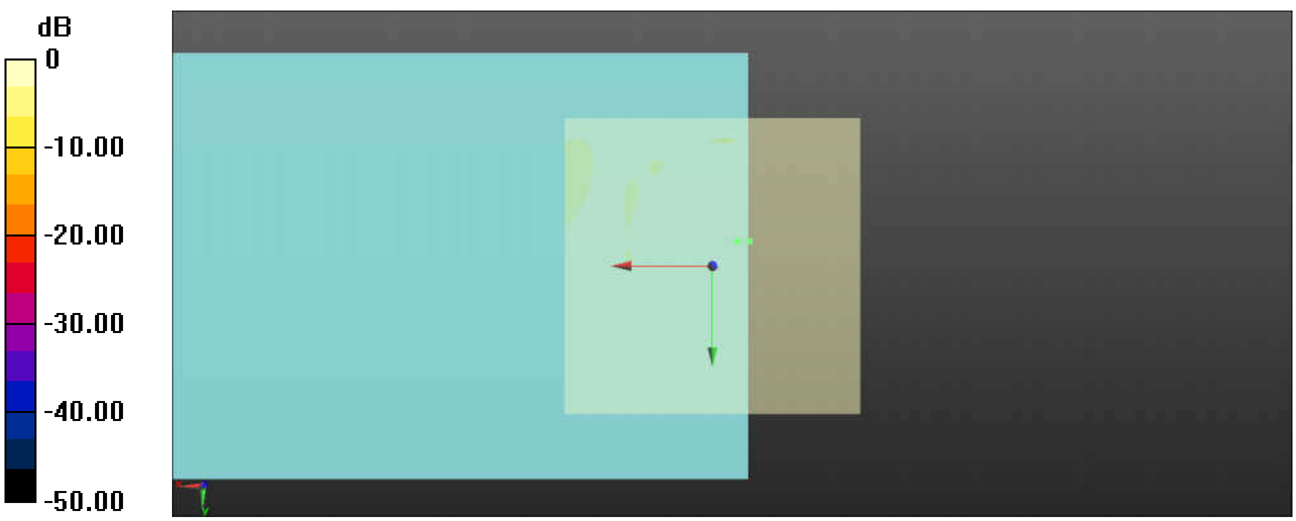
**09_HAC_T-Coil_LTE Band 7_20M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch21100(Z)**

Communication System: UID 0, FDD_LTE (0); Frequency: 2535 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

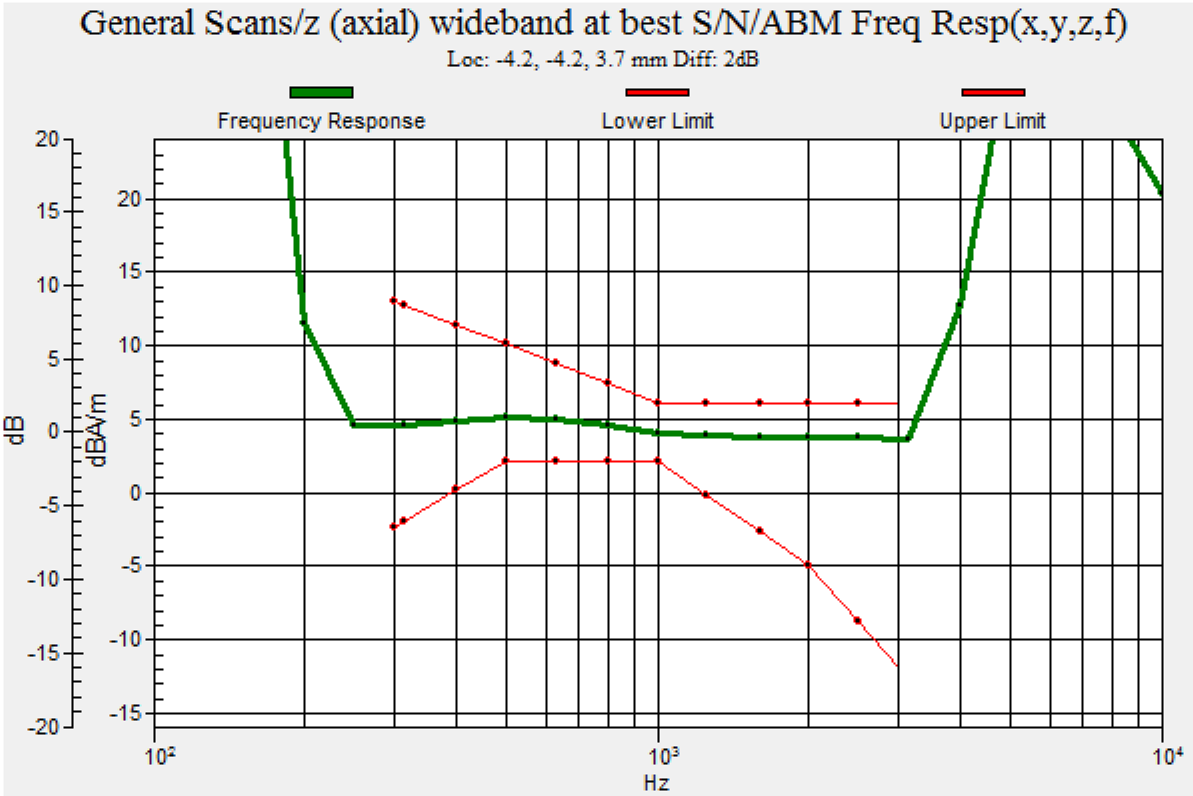
DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

## General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):

Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 43.05 dB
ABM1 comp = 0.84 dBA/m
Location: -6.2, -4.2, 3.7 mm




0 dB = 1.000 = 0.00 dB

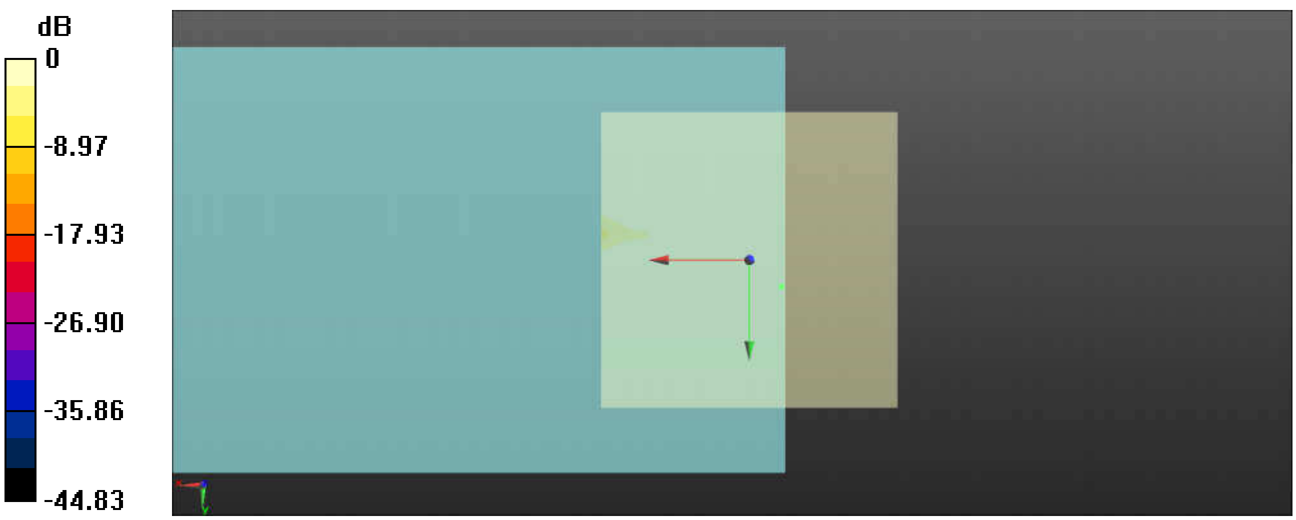

General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4.2, -4.2, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz
20
15
10
5
0
-5
-10
-15
-20
$10^2$
$10^3$
$10^4$

**09_HAC_T-Coil_LTE Band 7_20M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch21100(Y)**

Communication System: UID 0, FDD_LTE (0); Frequency: 2535 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- 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)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 38.42 dB
ABM1 comp = -6.11 dBA/m
Location: -5.4, 4.6, 3.7 mm




0 dB = 1.000 = 0.00 dB

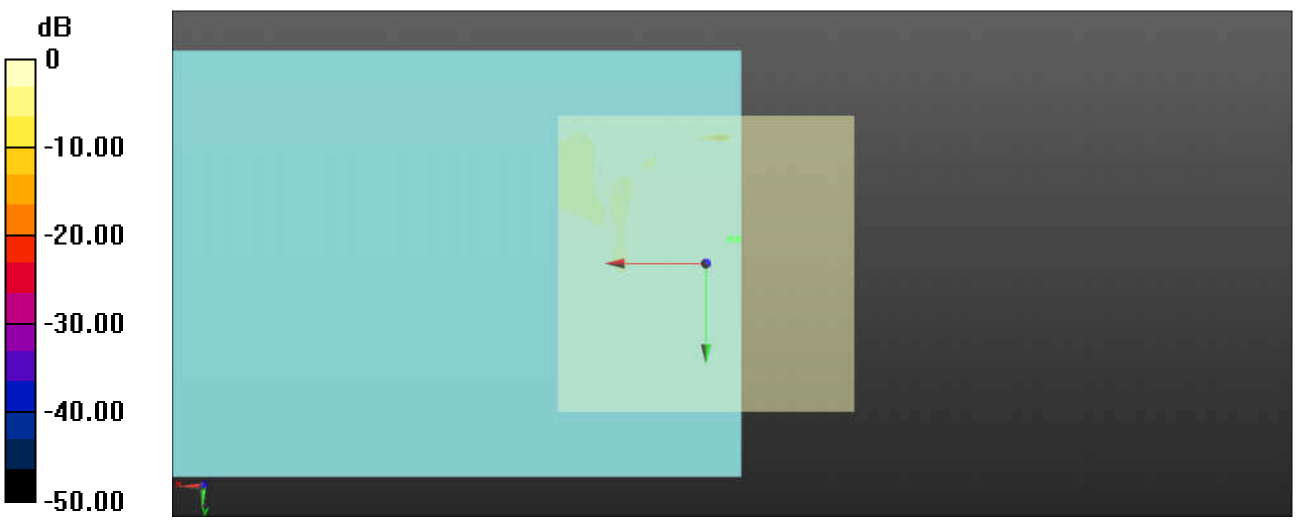
**10_HAC_T-Coil_LTE Band 12_10M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch23095(Z)**

Communication System: UID 0, FDD_LTE (0); Frequency: 707.5 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

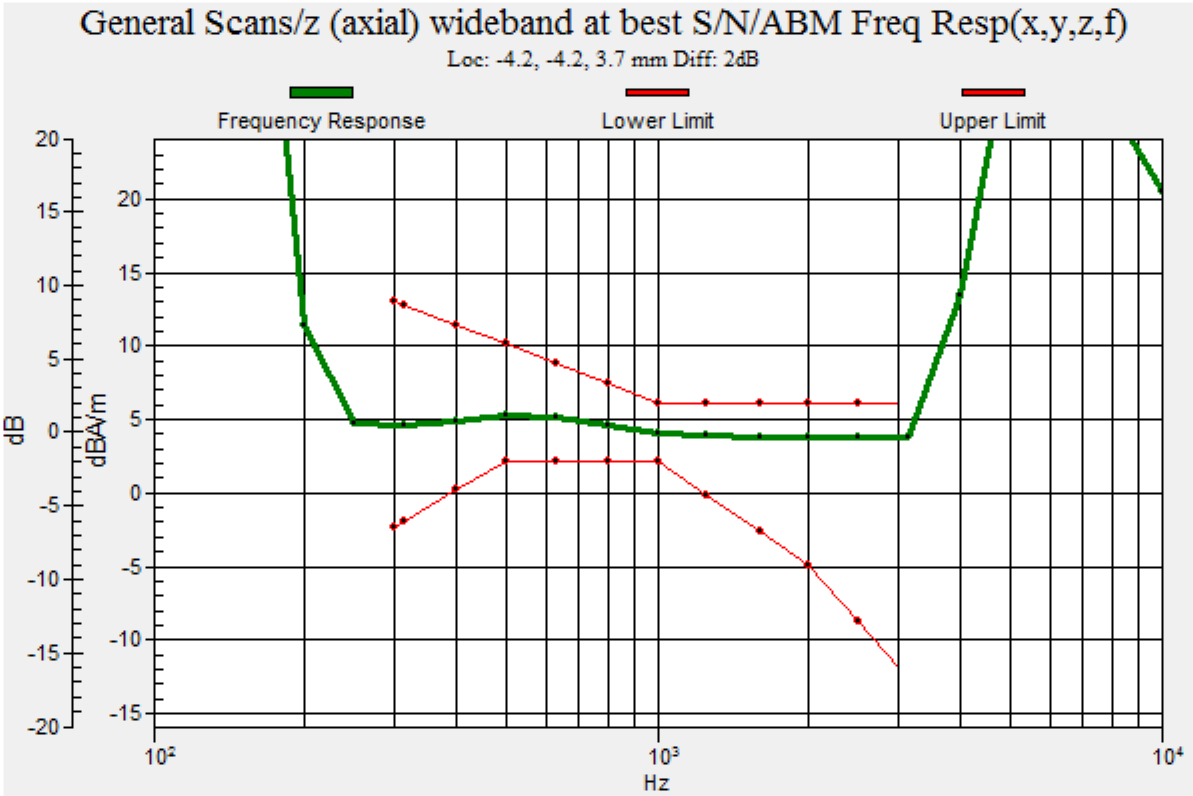
DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

## General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):

Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 42.45 dB
ABM1 comp = 2.25 dBA/m
Location: -5.4, -4.2, 3.7 mm




0 dB = 1.000 = 0.00 dB


General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4.2, -4.2, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz
20
15
10
5
0
-5
-10
-15
-20
$10^2$
$10^3$
$10^4$

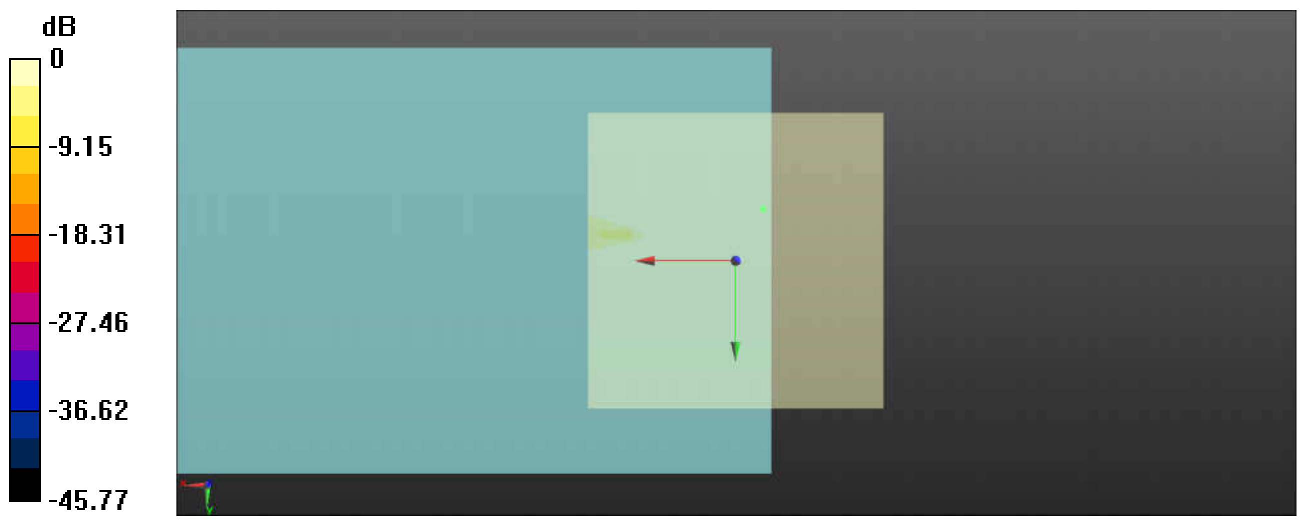
Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.6.2

**10_HAC_T-Coil_LTE Band 12_10M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch23095(Y)**

Communication System: UID 0, FDD_LTE (0); Frequency: 707.5 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- 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)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 38.64 dB
ABM1 comp = -7.91 dBA/m
Location: -4.6, -8.8, 3.7 mm




0 dB = 1.000 = 0.00 dB

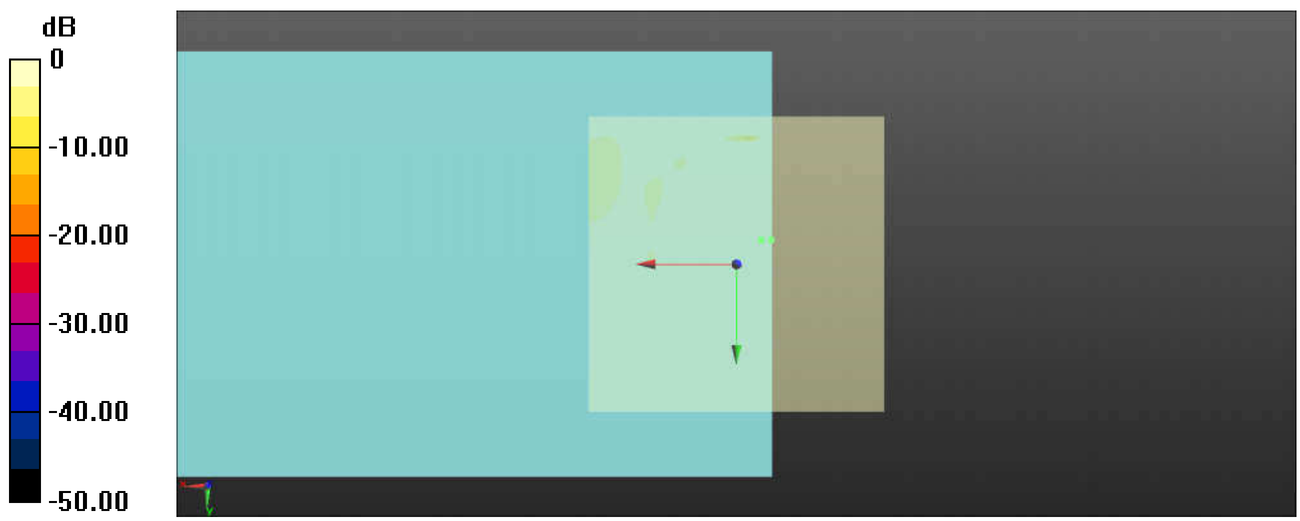
**11_HAC_T-Coil_LTE Band 13_10M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch23230(Z)**

Communication System: UID 0, FDD_LTE (0); Frequency: 782 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

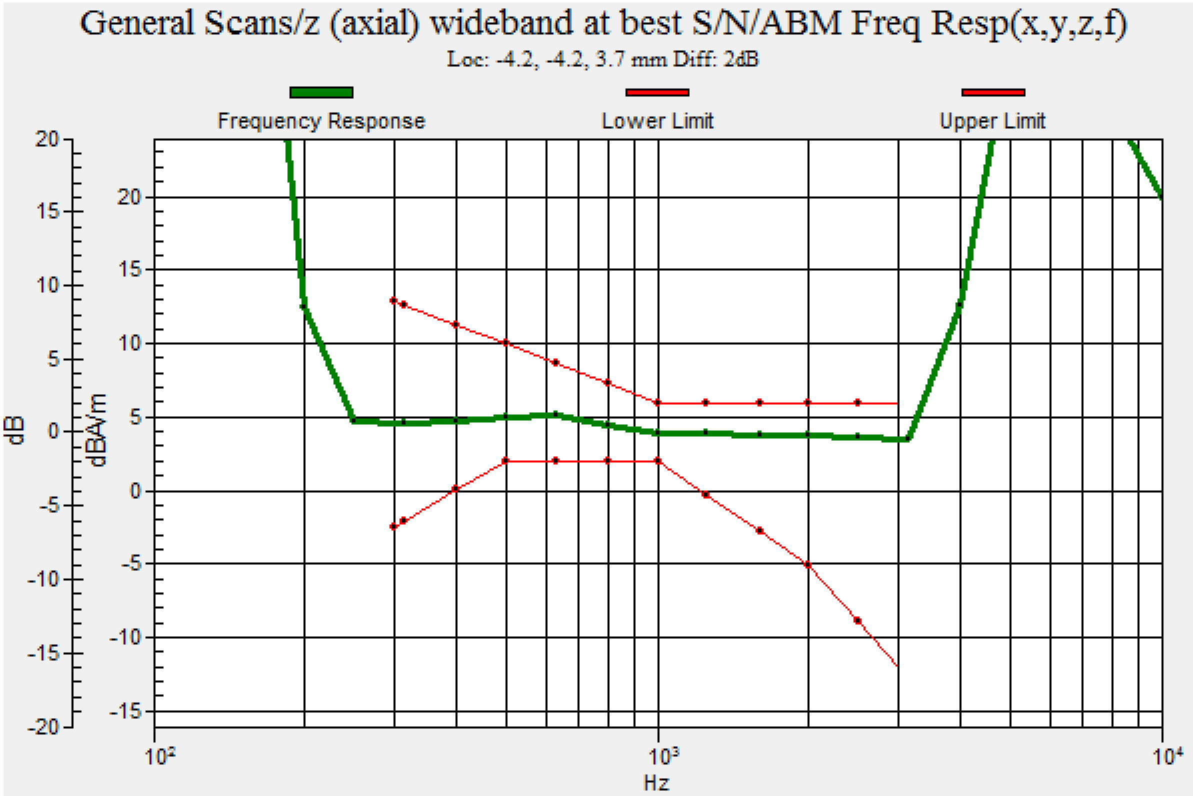
DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

## General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):

Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 42.57 dB
ABM1 comp = 1.52 dBA/m
Location: -5.8, -4.2, 3.7 mm




0 dB = 1.000 = 0.00 dB

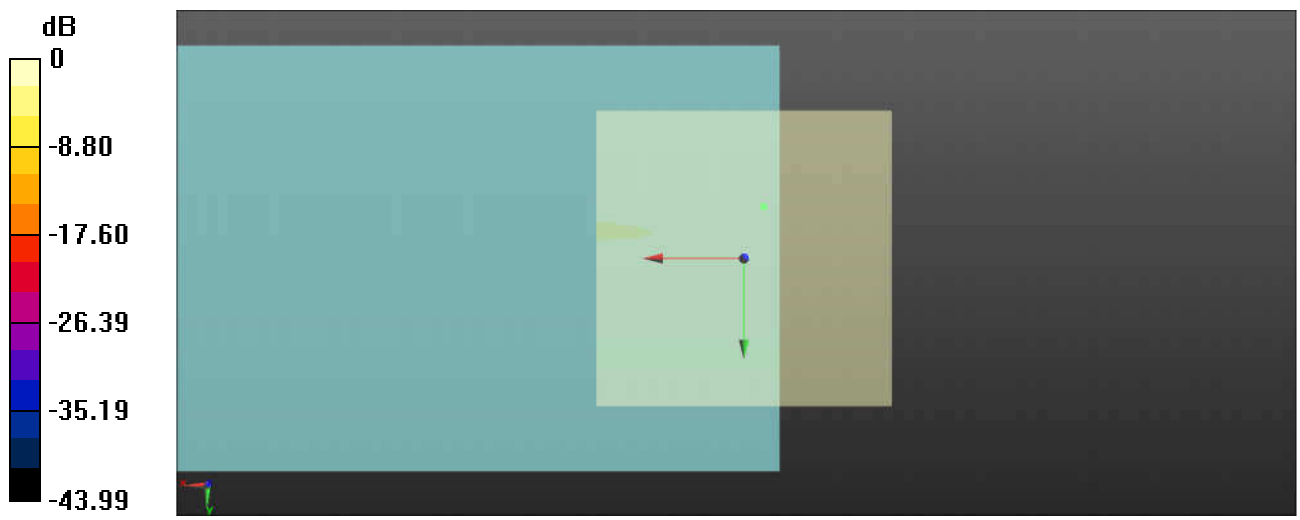

General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4.2, -4.2, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz
20
15
10
5
0
-5
-10
-15
-20
$10^2$
$10^3$
$10^4$

**11_HAC_T-Coil_LTE Band 13_10M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch23230(Y)**

Communication System: UID 0, FDD_LTE (0); Frequency: 782 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- 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)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 38.74 dB
ABM1 comp = -7.45 dBA/m
Location: -3.3, -8.8, 3.7 mm



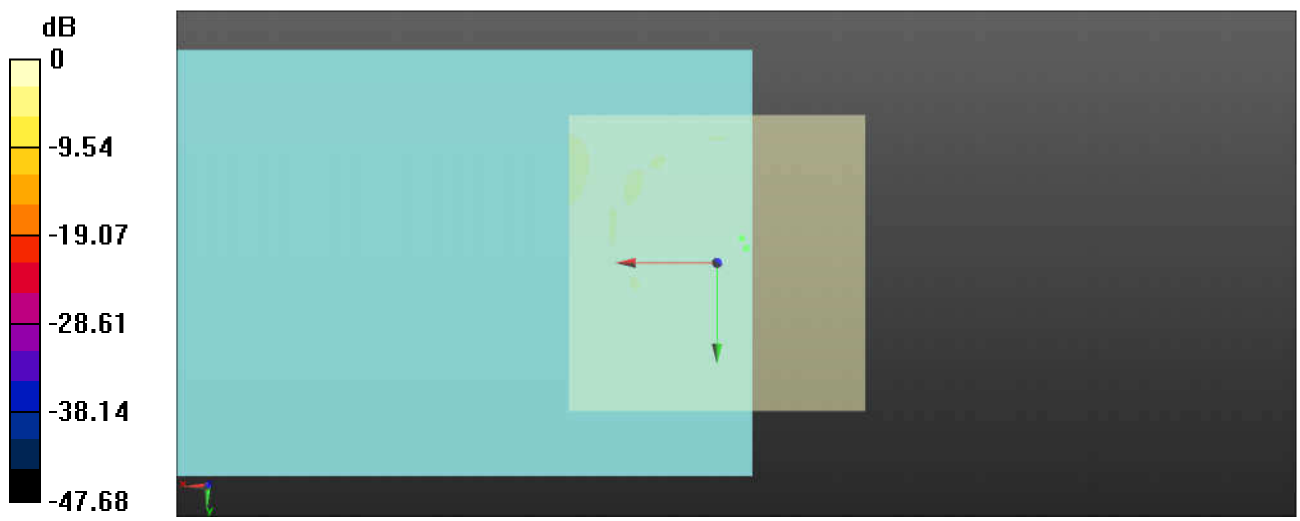

0 dB = 1.000 = 0.00 dB

**12_HAC_T-Coil_LTE Band 17_10M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch23790(Z)**

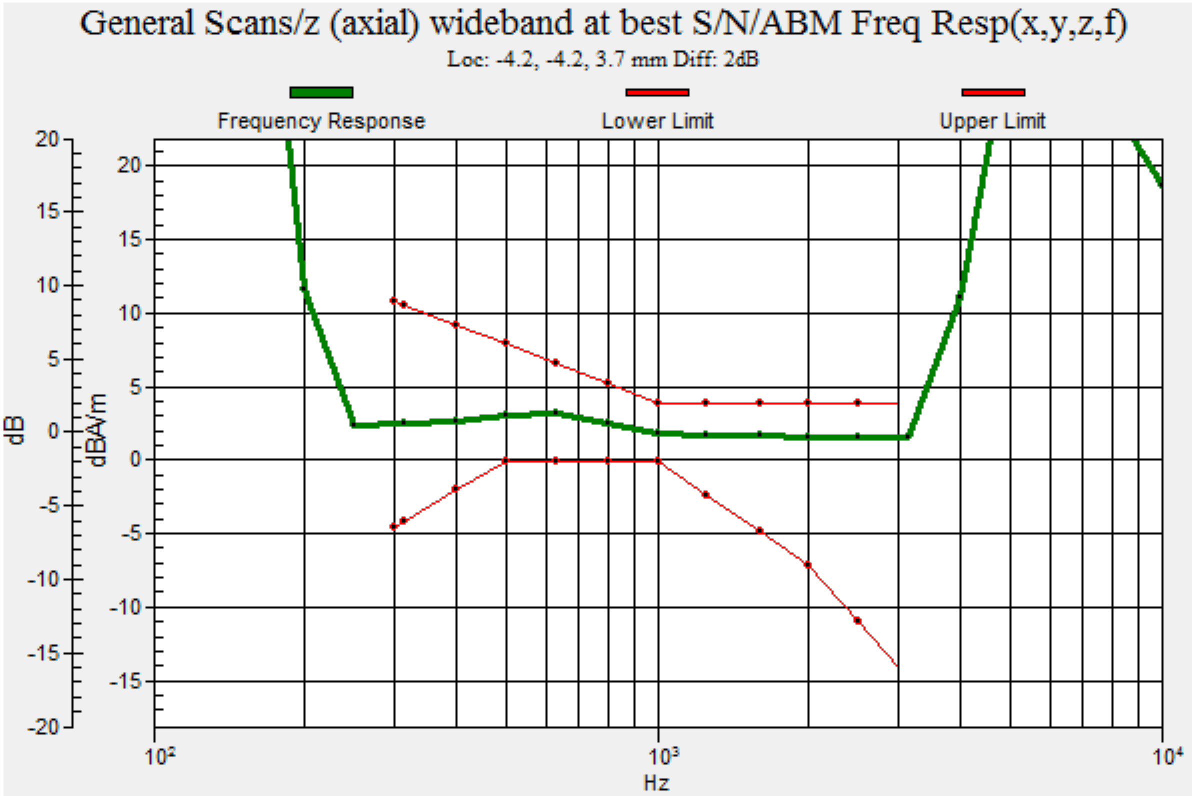
Communication System: UID 0, FDD_LTE (0); Frequency: 710 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- 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)

## General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 42.04 dB
ABM1 comp = 0.60 dBA/m
Location: -5, -2.5, 3.7 mm




0 dB = 1.000 = 0.00 dB


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

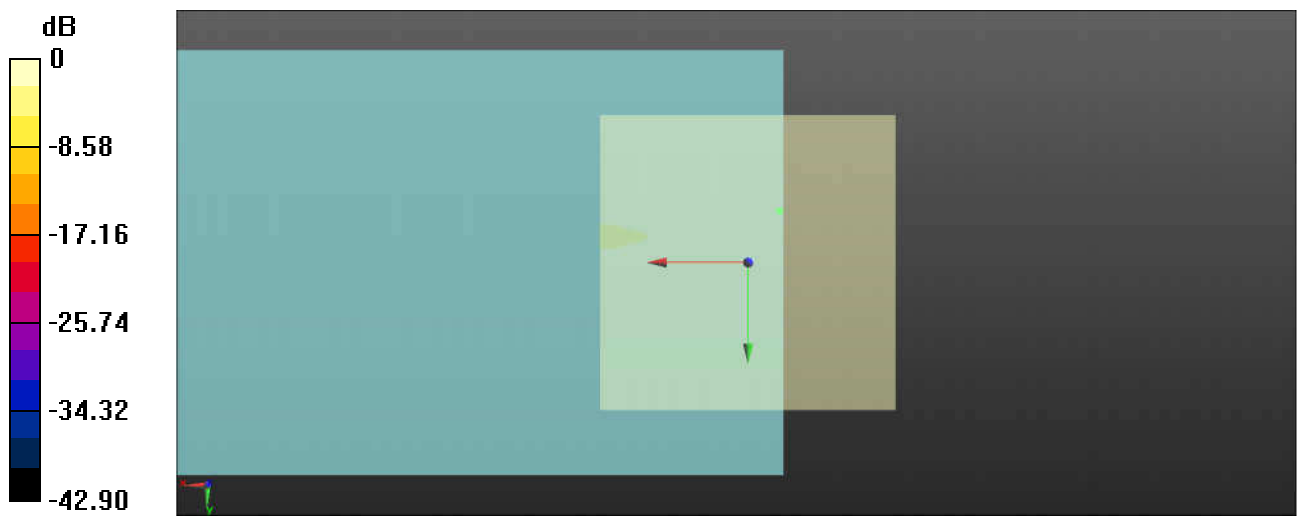
Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.6.2

**12_HAC_T-Coil_LTE Band 17_10M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch23790(Y)**

Communication System: UID 0, FDD_LTE (0); Frequency: 710 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- 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)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 37.61 dB
ABM1 comp = -10.37 dBA/m
Location: -5.4, -8.8, 3.7 mm




0 dB = 1.000 = 0.00 dB

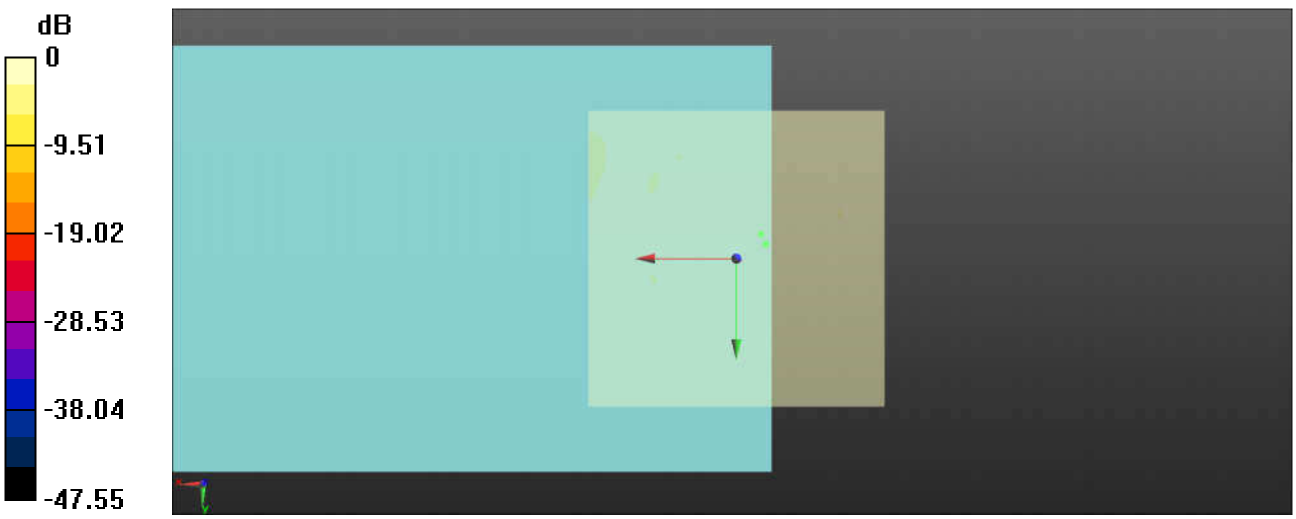
**13_HAC_T-Coil_LTE Band 66_20M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch132322(Z)**

Communication System: UID 0, FDD_LTE (0); Frequency: 1745 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

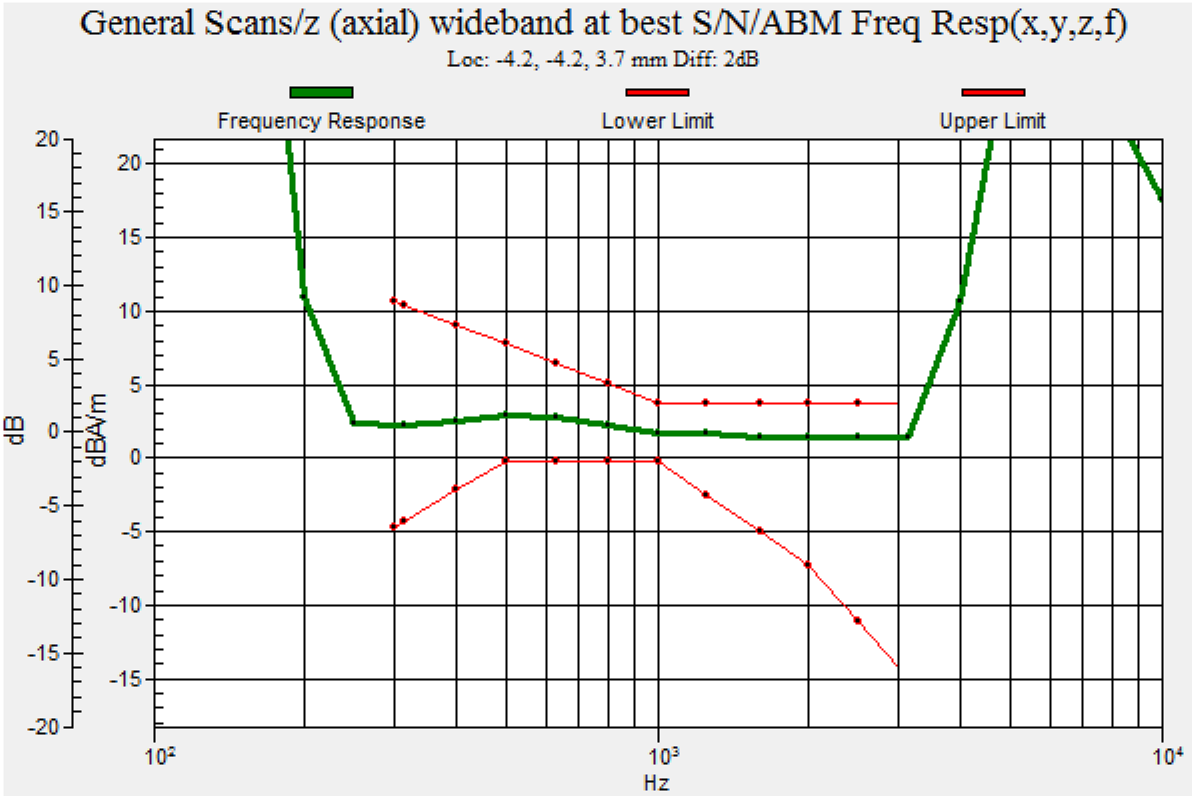
DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

## General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):

Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 42.33 dB
ABM1 comp = 0.36 dBA/m
Location: -5, -2.5, 3.7 mm




0 dB = 1.000 = 0.00 dB



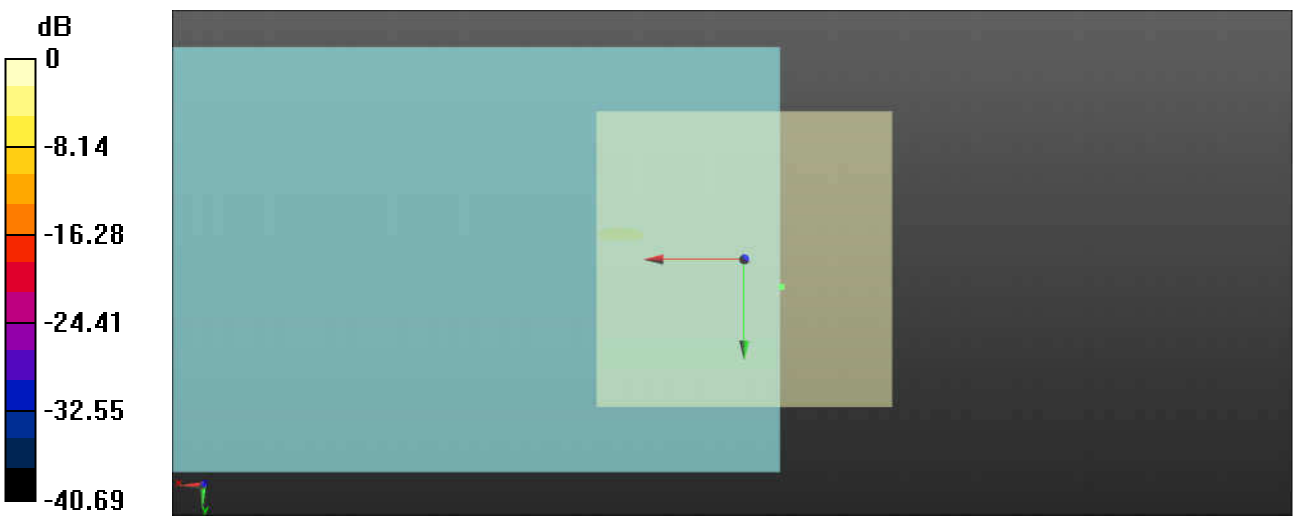
General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4.2, -4.2, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

**13_HAC_T-Coil_LTE Band 66_20M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch132322(Y)**

Communication System: UID 0, FDD_LTE (0); Frequency: 1745 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- 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)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 36.67 dB
ABM1 comp = -8.84 dBA/m
Location: -6.2, 4.6, 3.7 mm




0 dB = 1.000 = 0.00 dB

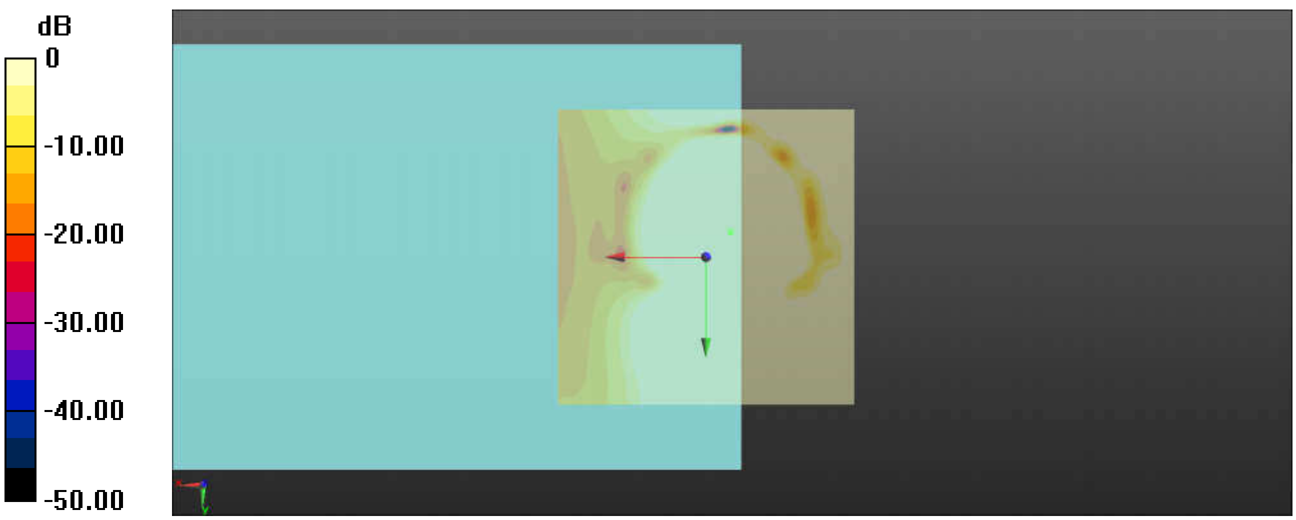
**14_HAC_T-Coil_LTE Band 38_20M_QPSK_1RB_0Offset_EVS-WB5.9Kbps_Ch38000(Z)**

Communication System: UID 0, TDD_LTE (0); Frequency: 2595 MHz;Duty Cycle: 1:1.59
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

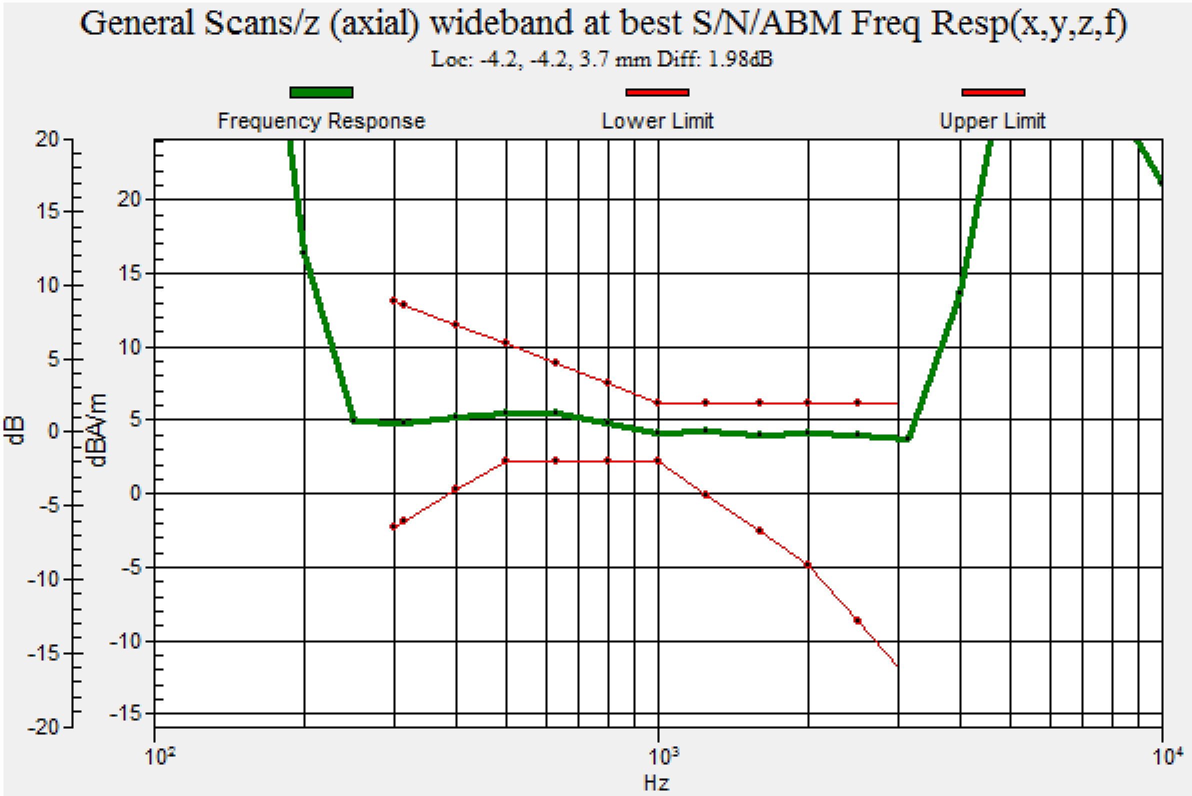
DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

## General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):

Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 35.63 dB
ABM1 comp = 3.69 dBA/m
Location: -4.2, -4.2, 3.7 mm




0 dB = 1.000 = 0.00 dB



General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4.2, -4.2, 3.7 mm Diff: 1.98dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

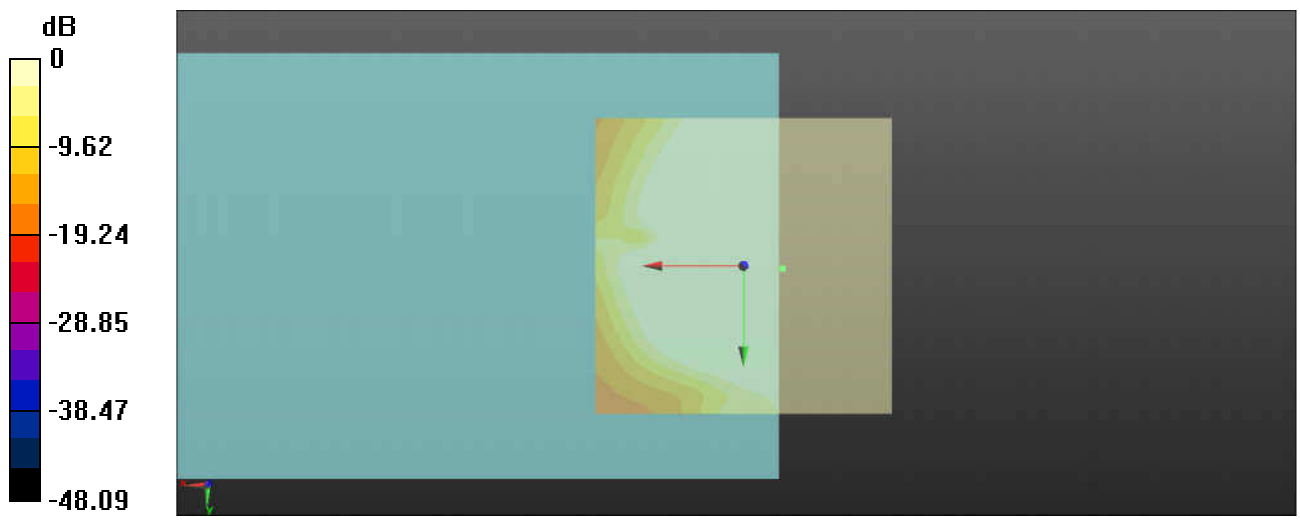
Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.6.2

**14_HAC_T-Coil_LTE Band 38_20M_QPSK_1RB_0Offset_EVS-WB 5.9Kbps_Ch38000(Y)**

Communication System: UID 0, TDD_LTE (0); Frequency: 2595 MHz;Duty Cycle: 1:1.59
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3128; ; Calibrated: 2017.12.20
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1279; Calibrated: 2018.1.3
- 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)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 30.20 dB
ABM1 comp = -12.87 dBA/m
Location: -6.7, 0.4, 3.7 mm



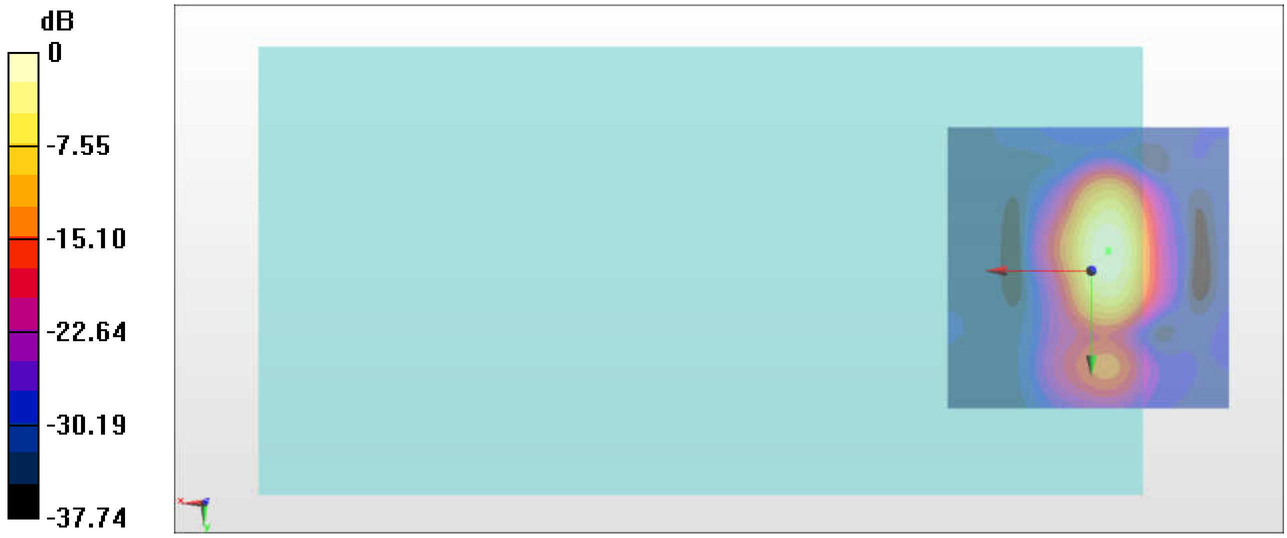

0 dB = 1.000 = 0.00 dB

## 15_HAC_T-Coil_GSM850_EDGE 2 Tx slots_Ch189_Axial (Z)

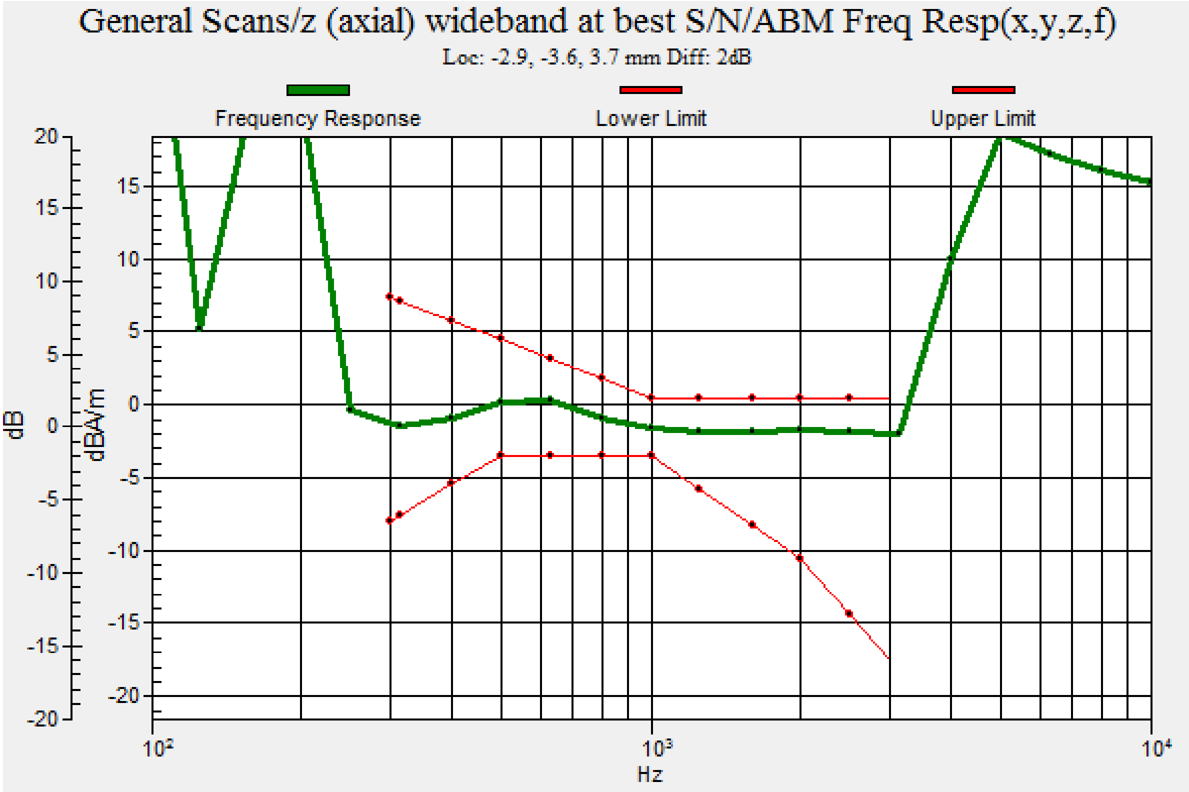
Communication System: GSM850 ; Frequency: 836.4 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 23.64 dB
ABM1 comp = -1.65 dBA/m
Location: -3, -3.3, 3.7 mm




0 dB = 15.21 = 23.64 dB

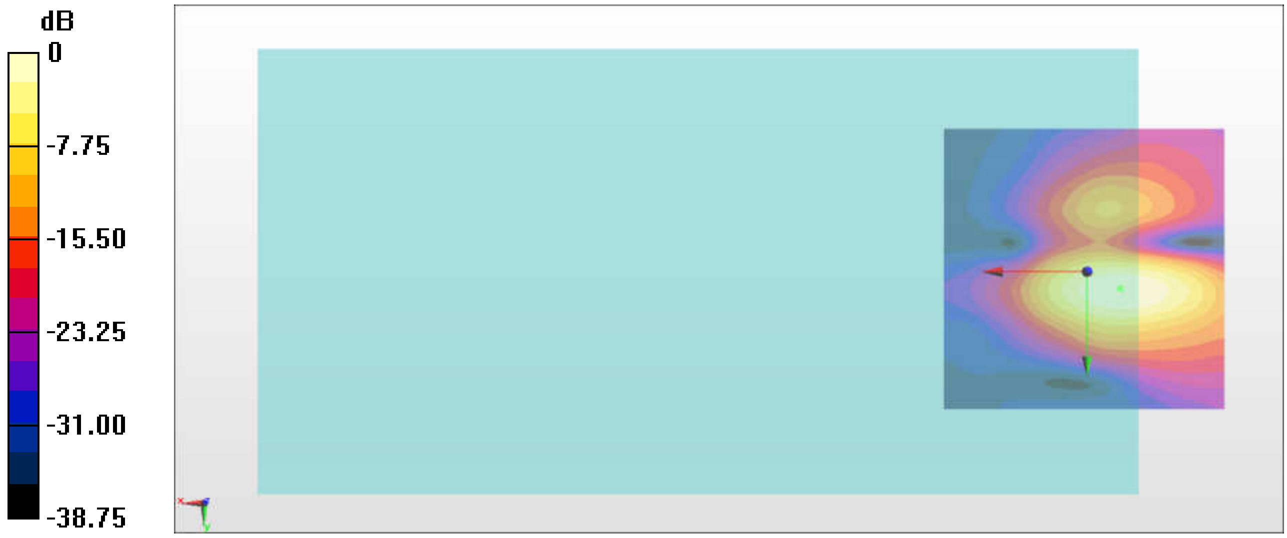

General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -2.9, -3.6, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz
20
15
10
5
0
-5
-10
-15
-20
$10^2$
$10^3$
$10^4$

## 15_HAC_T-Coil_GSM850_EDGE 2 Tx slots_Ch189_Transversal (Y)

Communication System: GSM850 ; Frequency: 836.4 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 24.59 dB
ABM1 comp = -10.02 dBA/m
Location: -5.8, 3, 3.7 mm



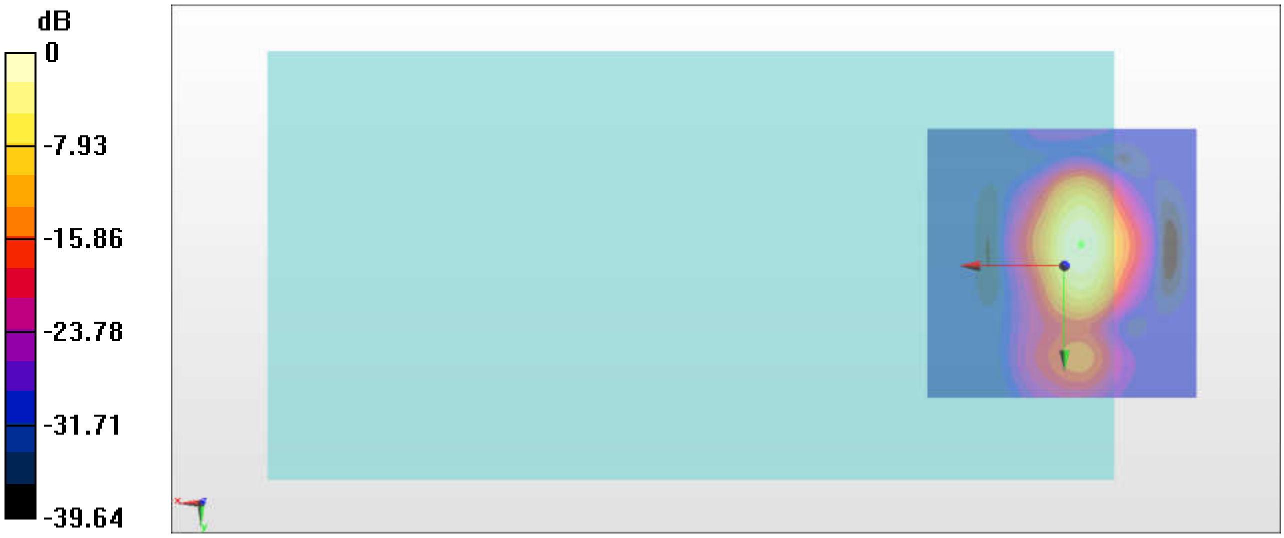

0 dB = 16.97 = 24.59 dB

# 16_HAC_T-Coil_GSM1900_EDGE 2 Tx slots_Ch661_Axial (Z)

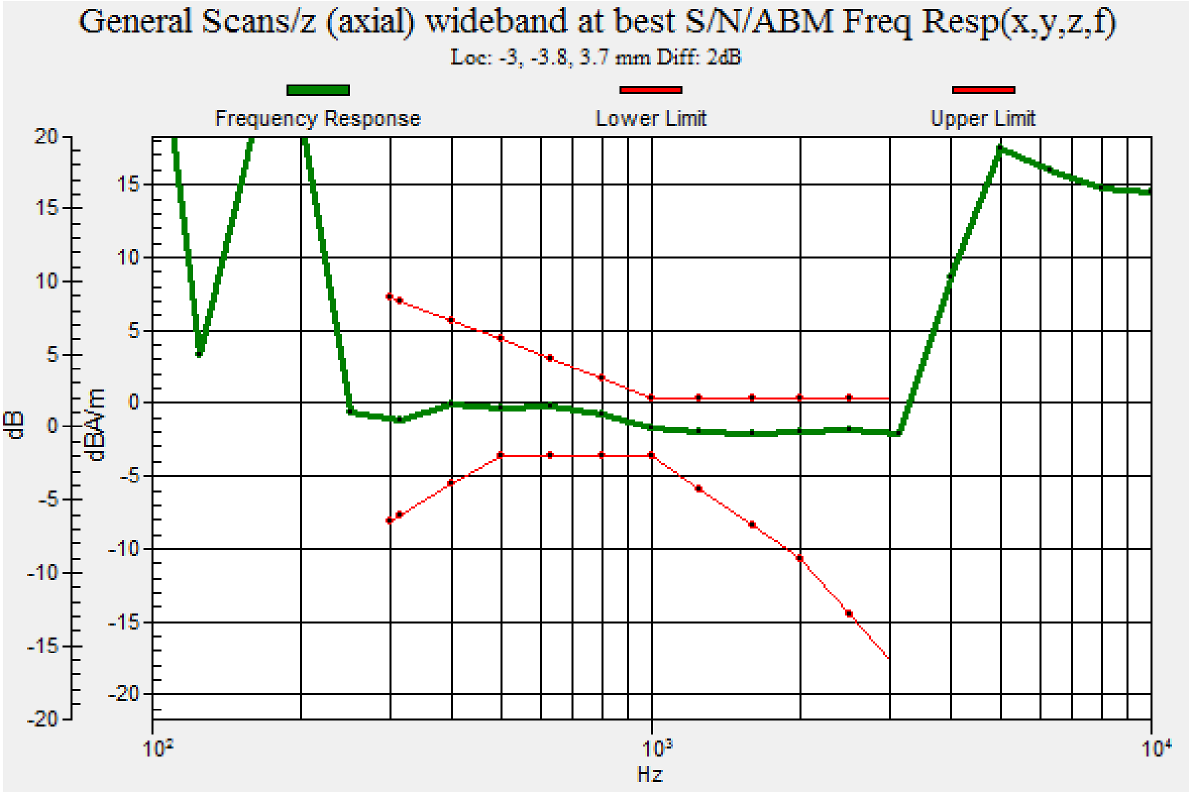
Communication System: PCS ; Frequency: 1880 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 23.81 dB
ABM1 comp = -2.19 dBA/m
Location: -3, -4, 3.7 mm




0 dB = 15.50 = 23.81 dB



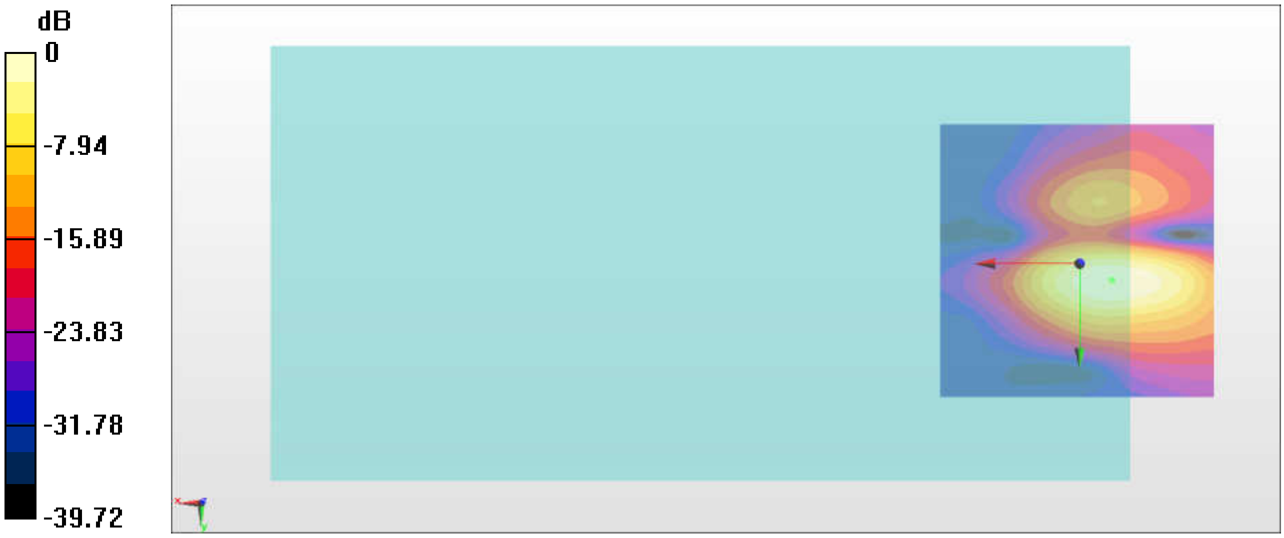
General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -3, -3.8, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

# 16_HAC_T-Coil_GSM1900_EDGE 2 Tx slots_Ch661_Transversal (Y)

Communication System: PCS ; Frequency: 1880 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 24.64 dB
ABM1 comp = -10.18 dBA/m
Location: -5.8, 3, 3.7 mm



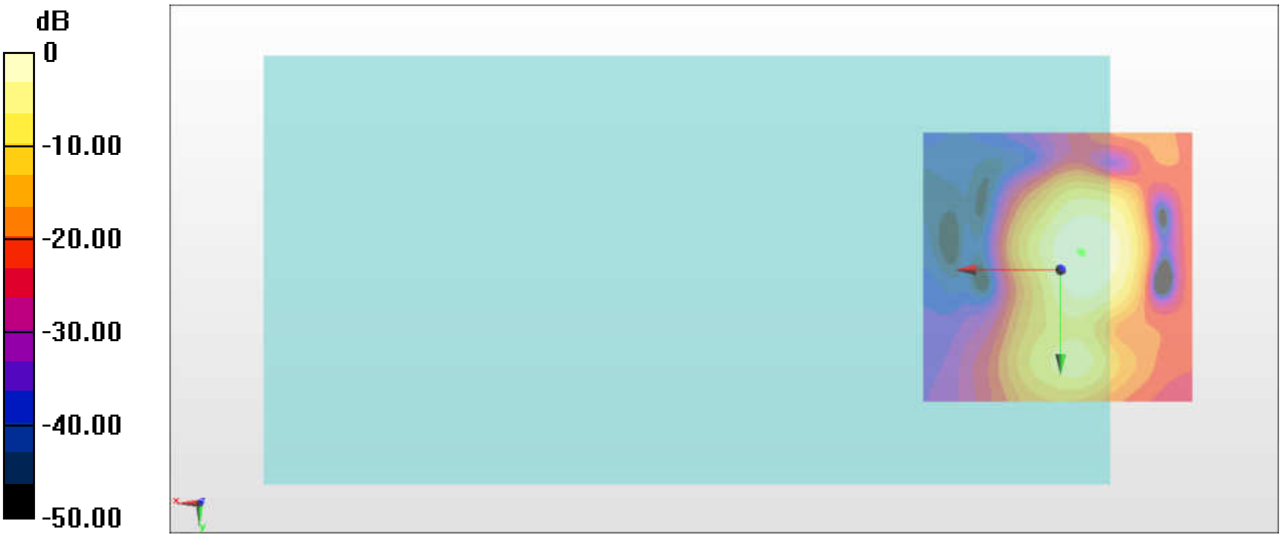

0 dB = 17.07 = 24.64 dB

## 17_HAC_T-Coil_WCDMA II_HSPA_Ch9400_Axial (Z)

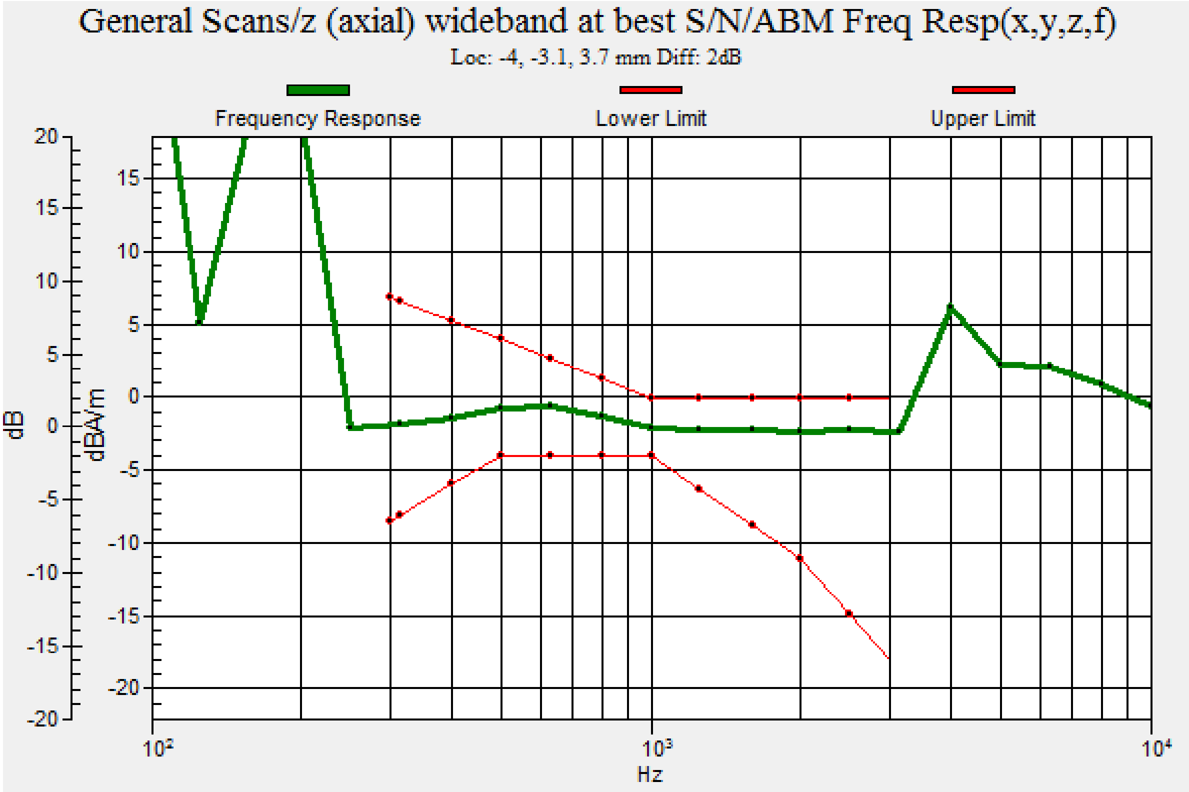
Communication System: WCDMA ; Frequency: 1880 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 34.11 dB
ABM1 comp = -1.70 dBA/m
Location: -3.7, -3.3, 3.7 mm




0 dB = 50.74 = 34.11 dB

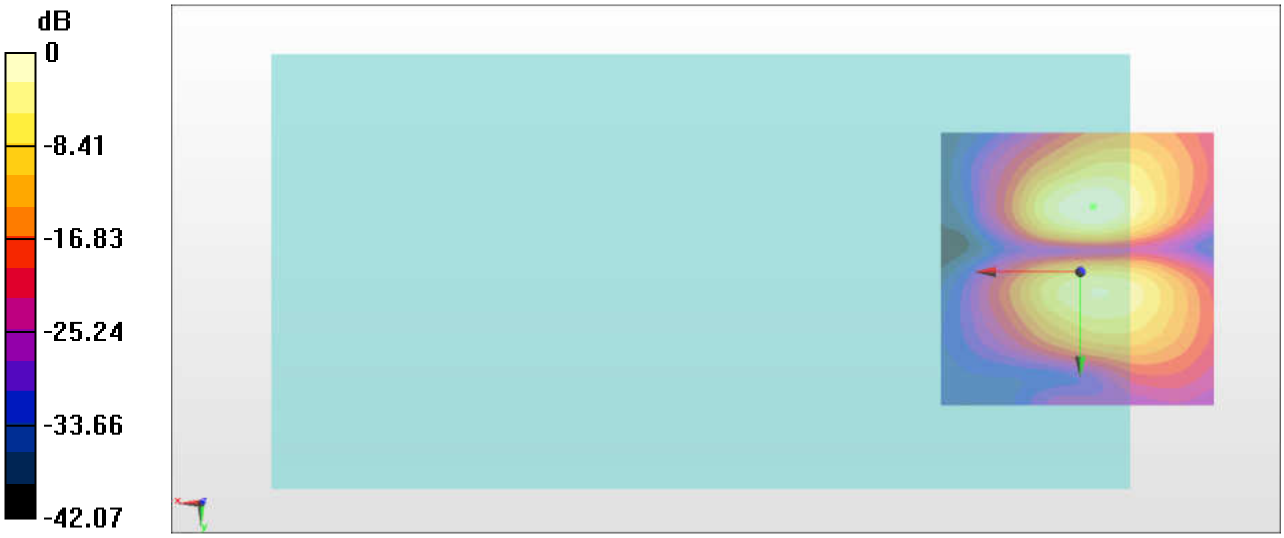

General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4, -3.1, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

## 17_HAC_T-Coil_WCDMA II_HSPA_Ch9400_Transversal (Y)

Communication System: WCDMA ; Frequency: 1880 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 32.75 dB
ABM1 comp = -11.22 dBA/m
Location: -2.3, -11.7, 3.7 mm



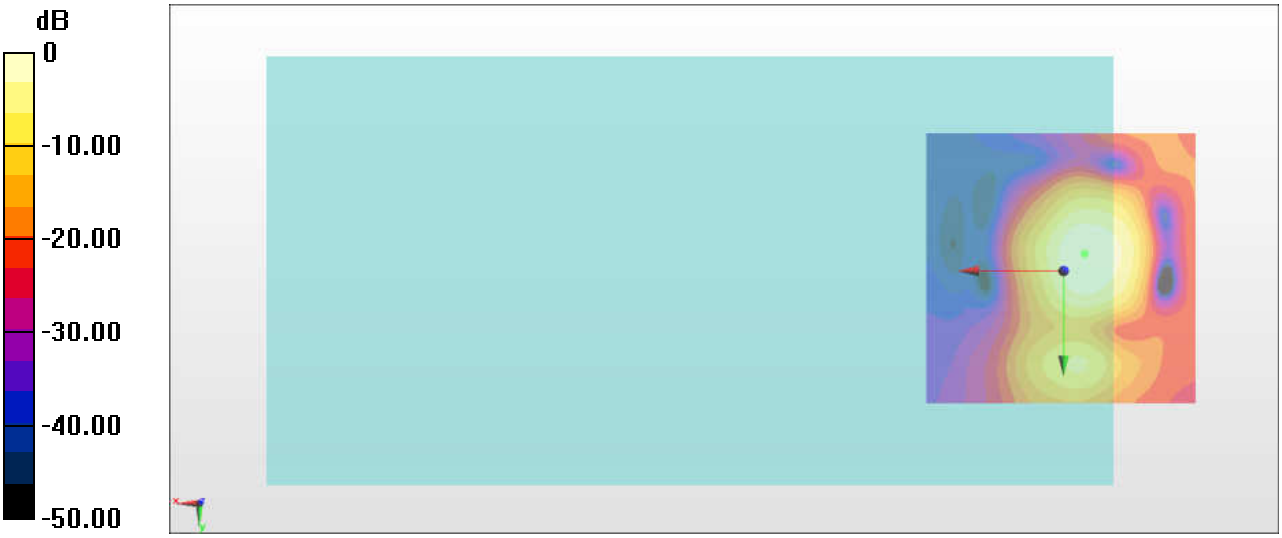

0 dB = 43.42 = 32.75 dB

## 18_HAC_T-Coil_WCDMA IV_HSPA_Ch1413_Axial (Z)

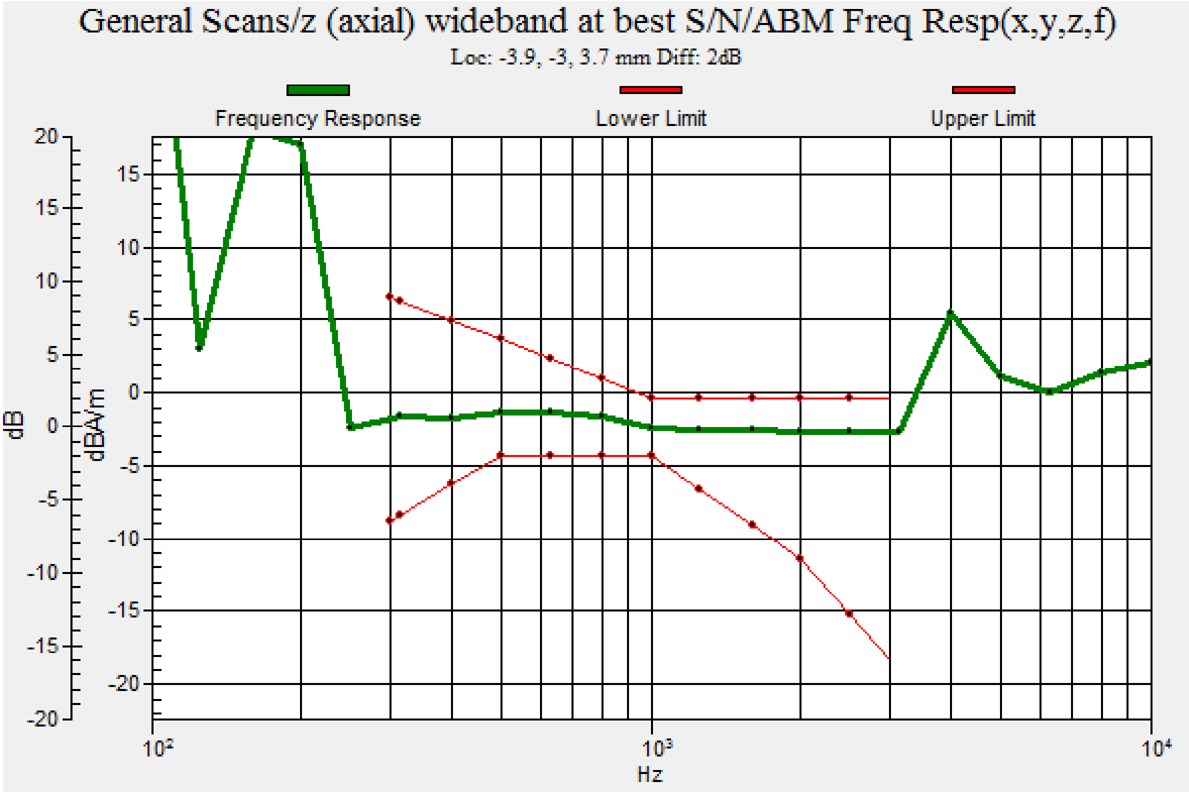
Communication System: WCDMA ; Frequency: 1732.6 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 32.00 dB
ABM1 comp = -4.42 dBA/m
Location: -3.7, -3.3, 3.7 mm




0 dB = 39.80 = 32.00 dB



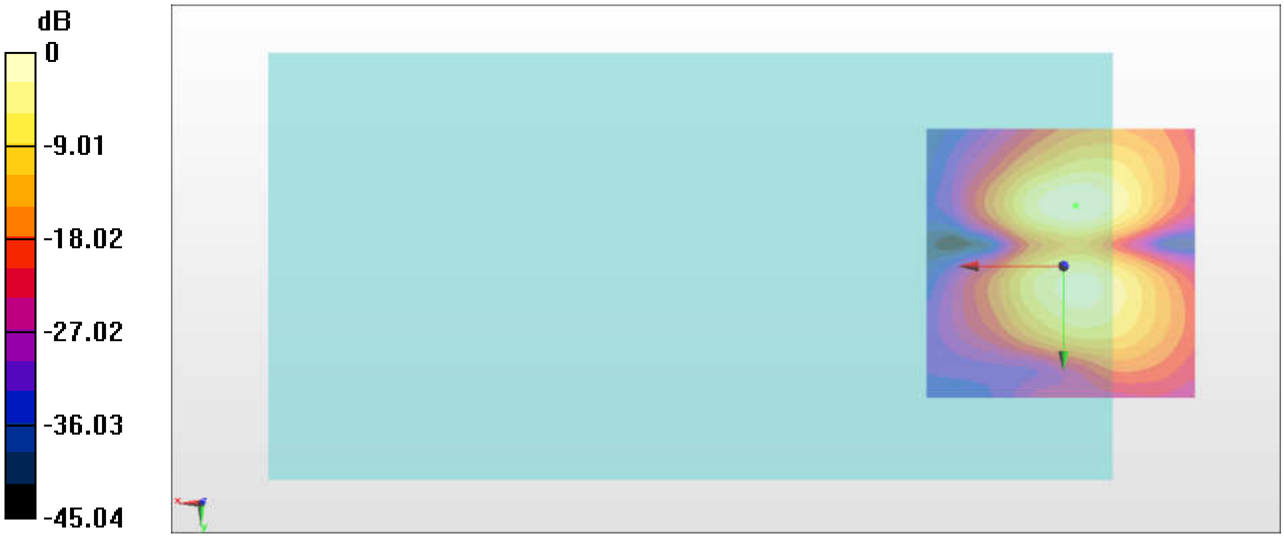
General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -3.9, -3, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

## 18_HAC_T-Coil_WCDMA IV_HSPA_Ch1413_Transversal (Y)

Communication System: WCDMA ; Frequency: 1732.6 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 31.78 dB
ABM1 comp = -11.91 dBA/m
Location: -2.3, -11, 3.7 mm



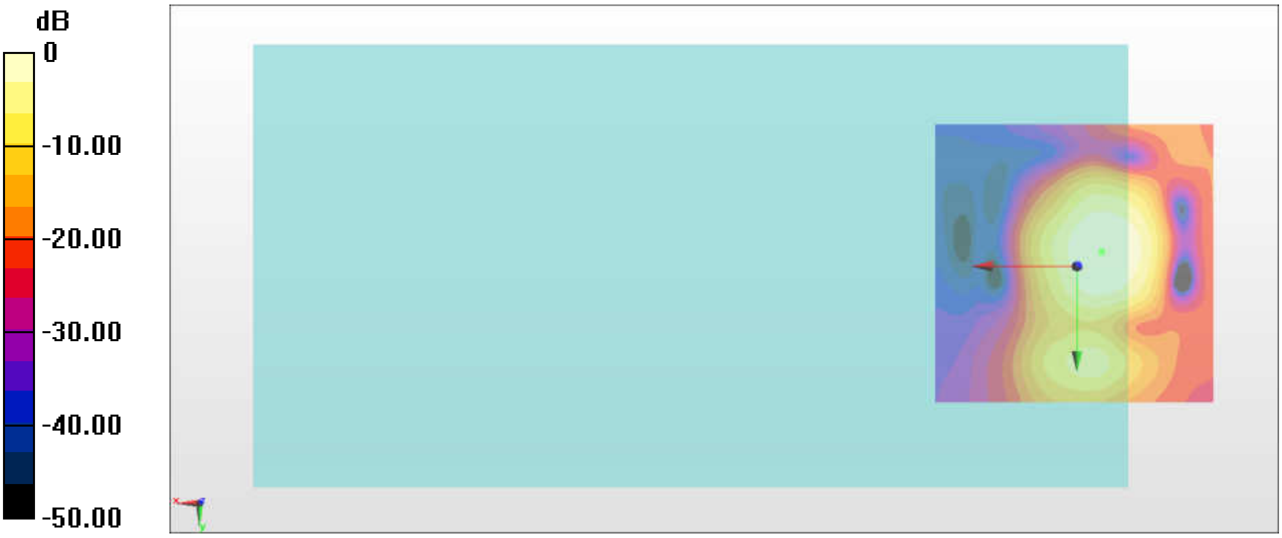

0 dB = 38.83 = 31.78 dB

# 19_HAC_T-Coil_WCDMA V_HSPA_Ch4182_Axial (Z)

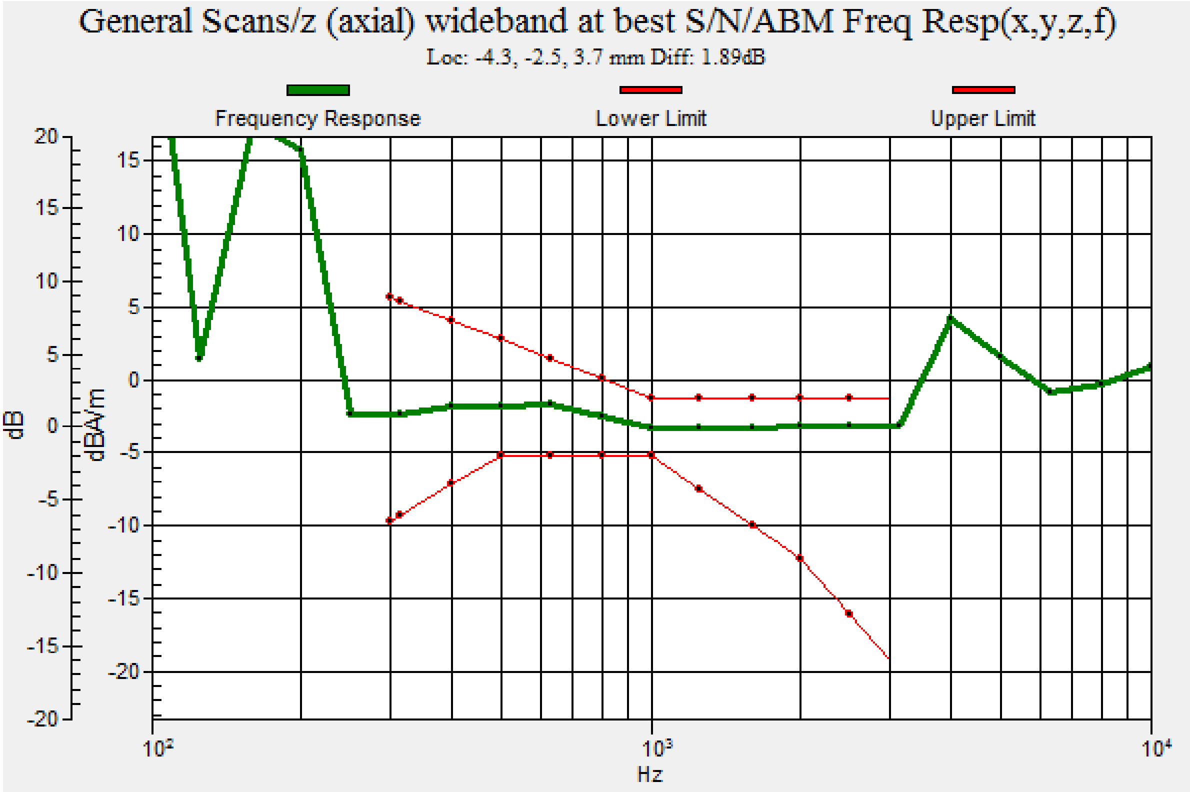
Communication System: WCDMA ; Frequency: 836.4 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 34.20 dB
ABM1 comp = -2.92 dBA/m
Location: -4.4, -2.6, 3.7 mm




0 dB = 51.31 = 34.20 dB

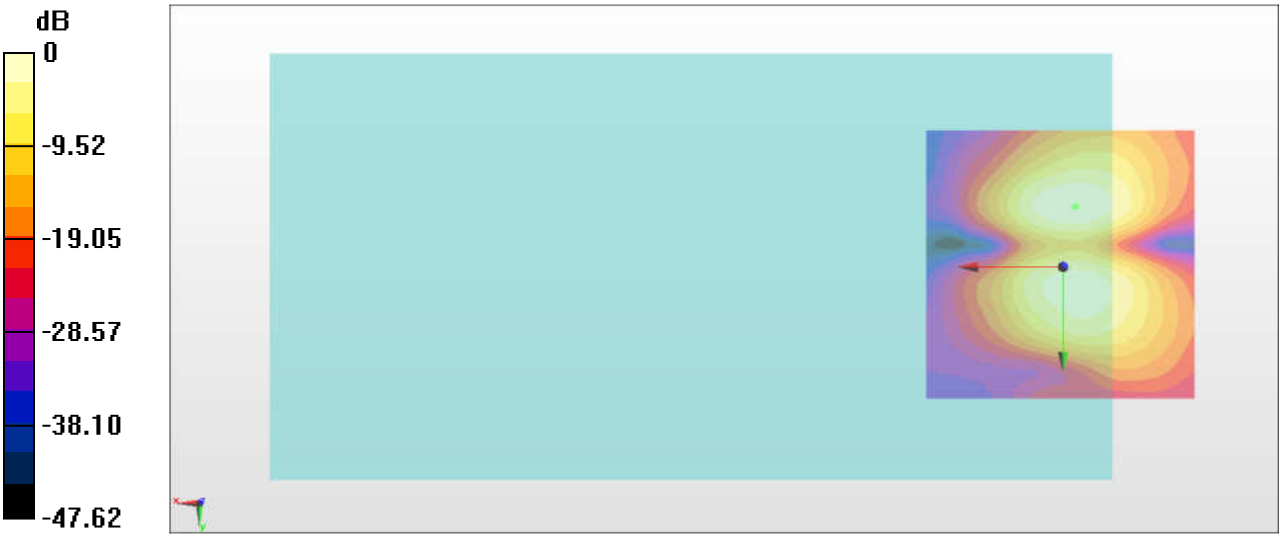

General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -4.3, -2.5, 3.7 mm Diff: 1.89dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

## 19_HAC_T-Coil_WCDMA V_HSPA_Ch4182_Transversal (Y)

Communication System: WCDMA ; Frequency: 836.4 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 33.59 dB
ABM1 comp = -9.53 dBA/m
Location: -2.3, -11, 3.7 mm



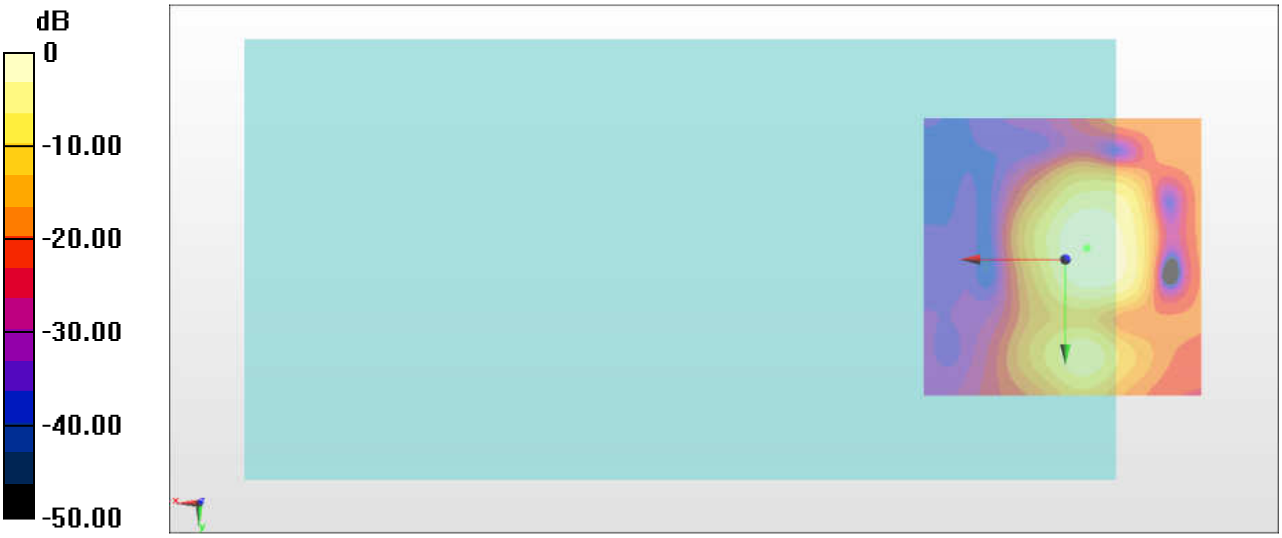

0 dB = 47.83 = 33.59 dB

# 20_HAC_T-Coil_LTE Band 66_20M_QPSK_1RB_0Offset_Ch132322_Axial (Z)

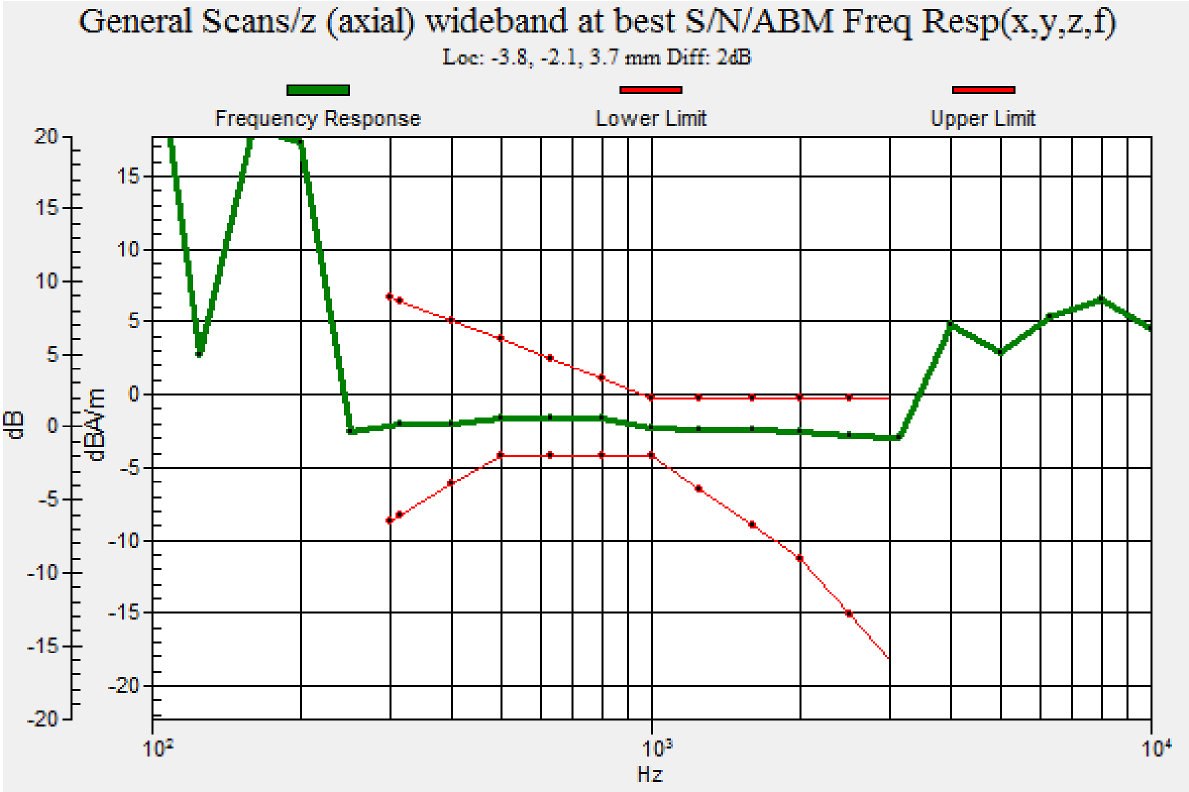
Communication System: LTE ; Frequency: 1745 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 31.19 dB
ABM1 comp = -2.54 dBA/m
Location: -3.7, -1.9, 3.7 mm




0 dB = 36.25 = 31.19 dB



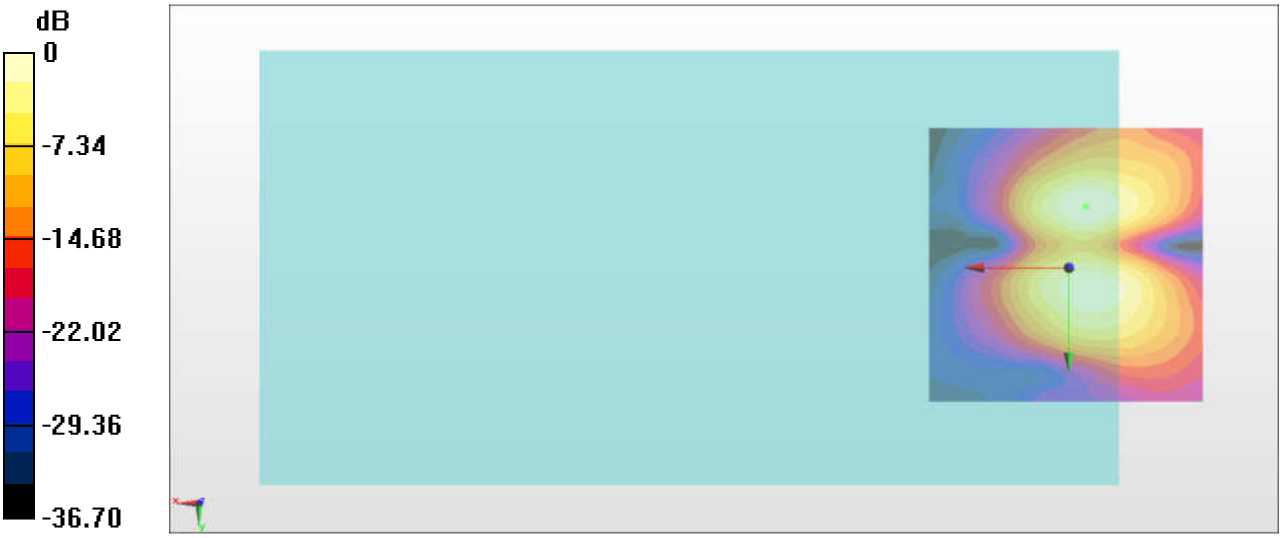
General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -3.8, -2.1, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
20
15
10
5
0
-5
-10
-15
-20
Hz
$10^2$
$10^3$
$10^4$

## 20_HAC_T-Coil_LTE Band 66_20M_QPSK_1RB_0Offset_Ch132322_Transversal (Y)

Communication System: LTE ; Frequency: 1745 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 30.99 dB
ABM1 comp = -9.15 dBA/m
Location: -3, -11, 3.7 mm



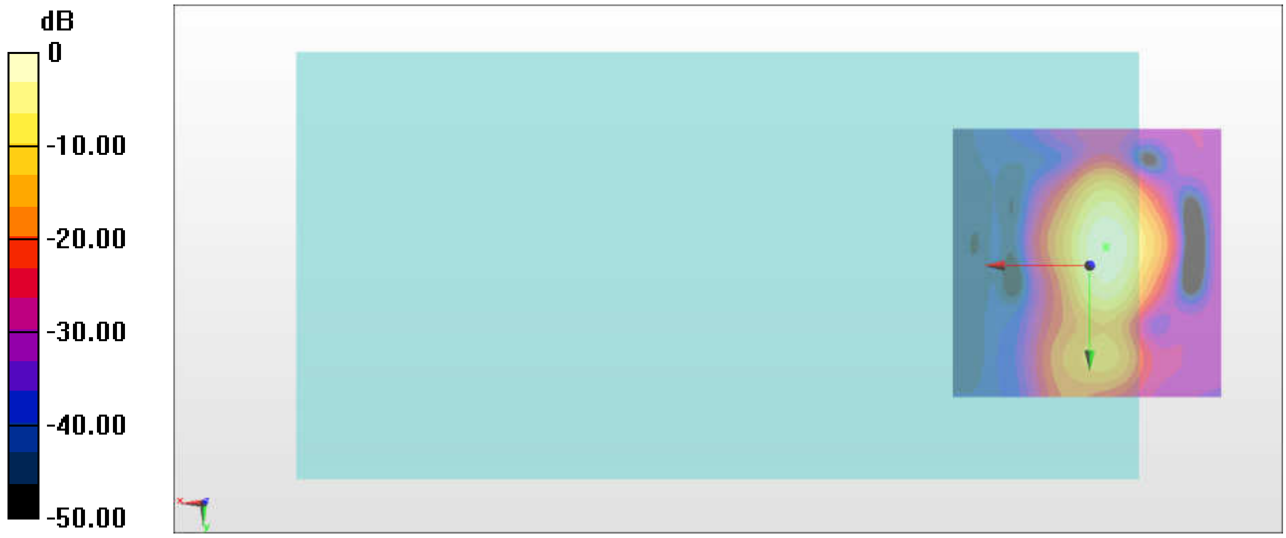

0 dB = 35.44 = 30.99 dB

## 21_HAC_T-Coil_LTE Band 38_20M_QPSK_1RB_0Offset_Ch38000_Axial (Z)

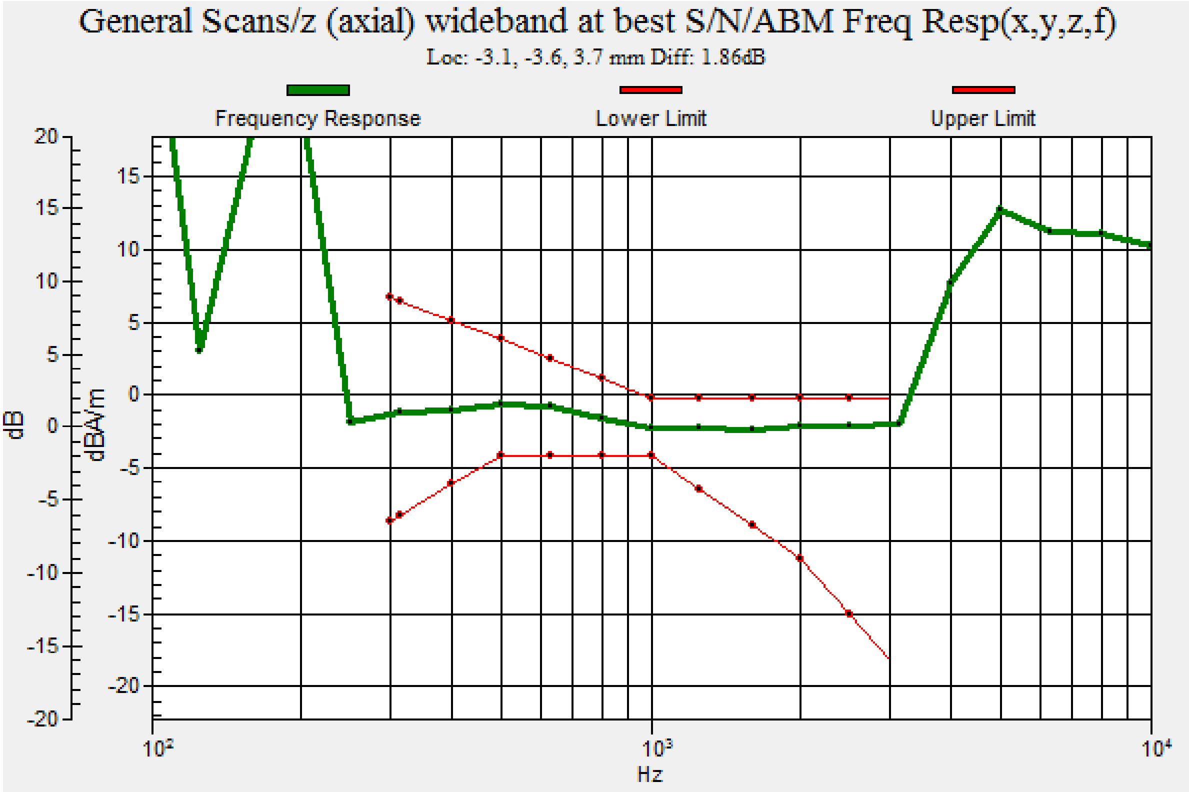
Communication System: LTE TDD ; Frequency: 2595 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 27.16 dB
ABM1 comp = -2.02 dBA/m
Location: -3, -3.3, 3.7 mm




0 dB = 22.80 = 27.16 dB



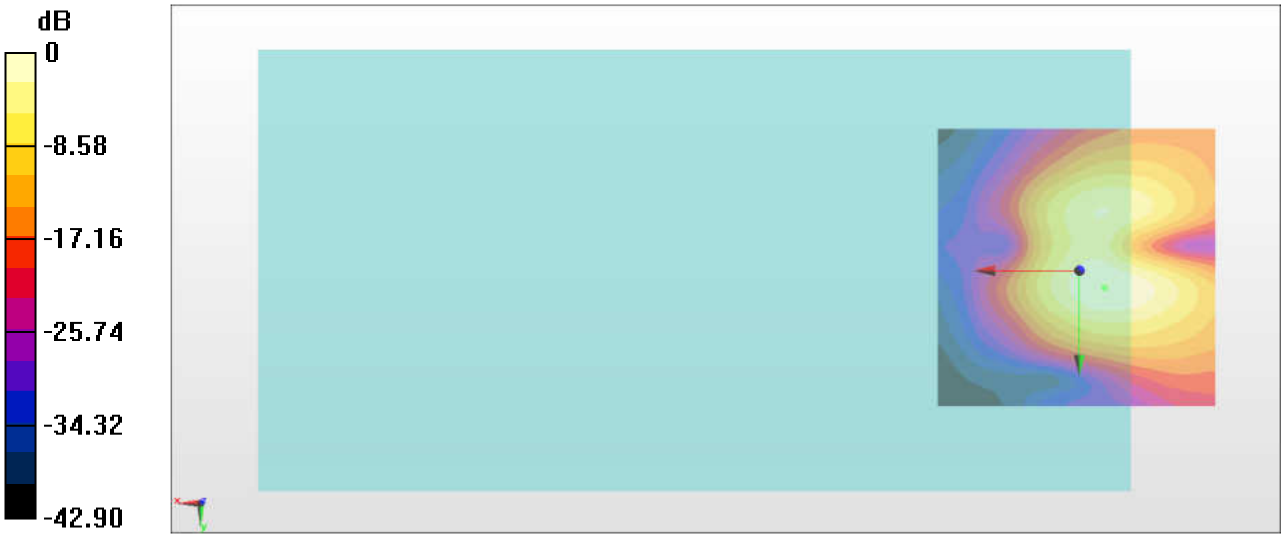
General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -3.1, -3.6, 3.7 mm Diff: 1.86dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz

## 21_HAC_T-Coil_LTE Band 38_20M_QPSK_1RB_0Offset_Ch38000_Transversal (Y)

Communication System: LTE TDD ; Frequency: 2595 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 23.21 dB
ABM1 comp = -8.95 dBA/m
Location: -4.4, 3, 3.7 mm



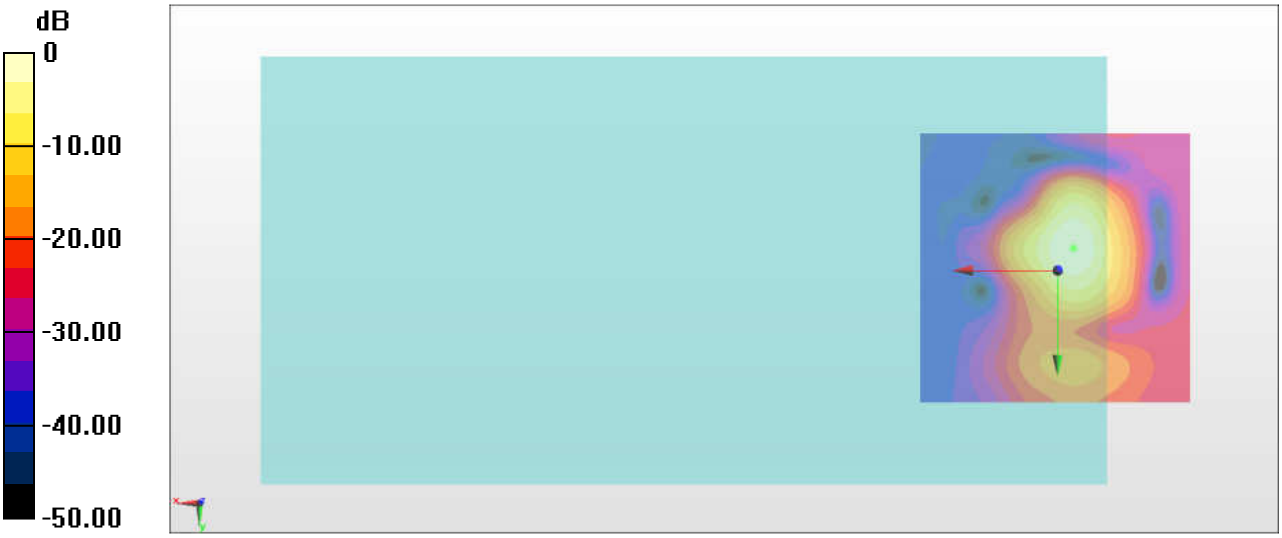

0 dB = 14.47 = 23.21 dB

# 22_HAC_T-Coil_WLAN2.4GHz_802.11b 1Mbps_Ch6_Axial (Z)

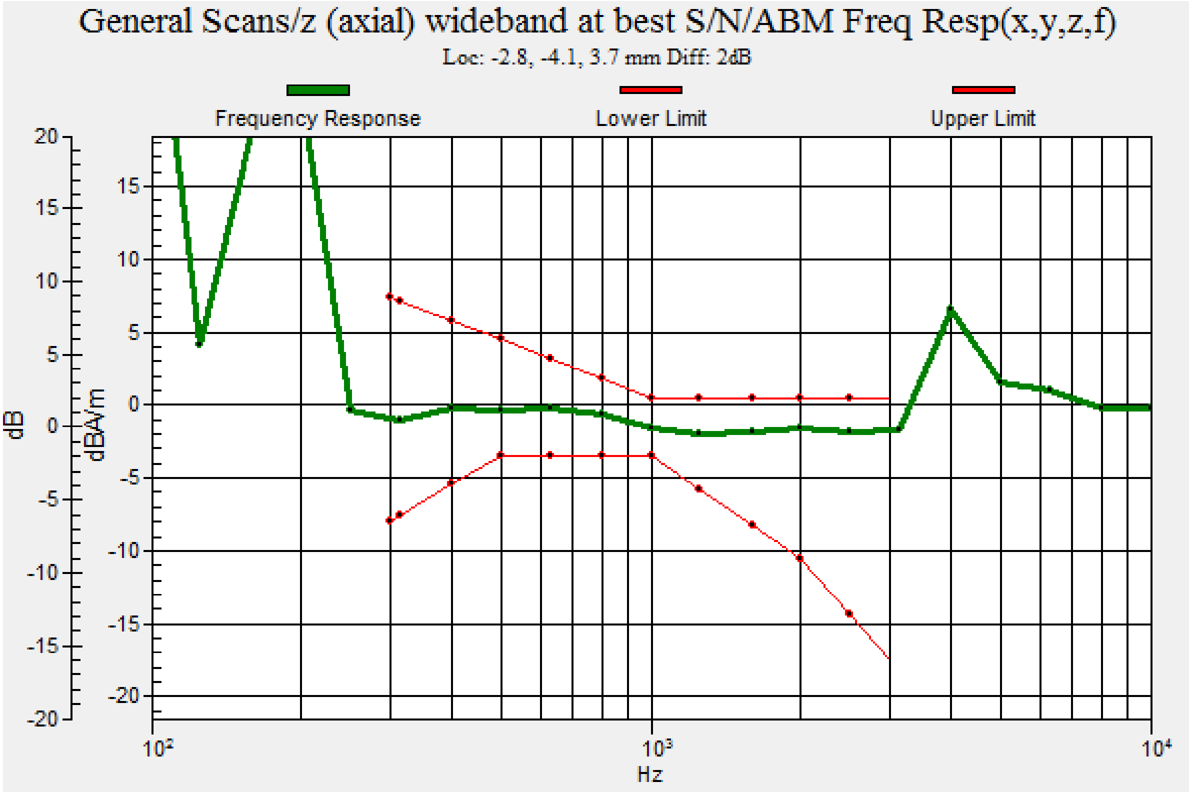
Communication System: 802.11b ; Frequency: 2437 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/z (axial) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 32.54 dB
ABM1 comp = -1.57 dBA/m
Location: -3, -4, 3.7 mm




0 dB = 42.36 = 32.54 dB

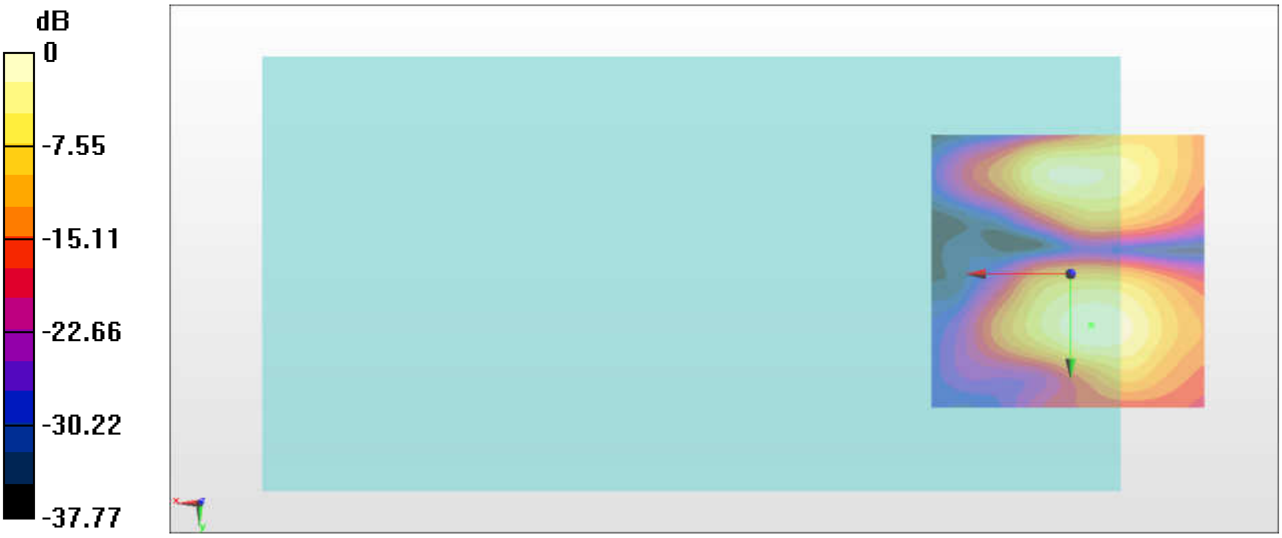

General Scans/z (axial) wideband at best S/N/ABM Freq Resp(x,y,z,f)
Loc: -2.8, -4.1, 3.7 mm Diff: 2dB
Frequency Response
Lower Limit
Upper Limit
dB
dBA/m
Hz
$10^2$
$10^3$
$10^4$

## 22_HAC_T-Coil_WLAN2.4GHz_802.11b 1Mbps_Ch6_Transversal (Y)

Communication System: 802.11b ; Frequency: 2437 MHz
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m$^3$
Ambient Temperature：23.5 ℃

DASY5 Configuration:
- Probe: AM1DV3 - 3130; ; Calibrated: 2017/11/21
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1424; Calibrated: 2018/1/18
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

**General Scans/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1):**
Interpolated grid: dx=1.000 mm, dy=1.000 mm
ABM1/ABM2 = 27.67 dB
ABM1 comp = -10.26 dBA/m
Location: -3.7, 9.3, 3.7 mm




0 dB = 24.17 = 27.67 dB

# Appendix B. Calibration Data

The DASY calibration certificates are shown as follows.

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1386

# IMPORTANT NOTICE

## USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

**Battery Exchange**: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

**Shipping of the DAE**: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

**E-Stop Failures**: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

**Repair**: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

**DASY Configuration Files:** Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

**Important Note:**
**Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.**

**Important Note:**
**Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.**

**Important Note:**
**To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.**

Schmid & Partner Engineering

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

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

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

**Accreditation No.: SCS 0108**

**Client** Sporton (Auden) - SZ

**Certificate No: DAE4-1386_Jul17**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | DAE4 - SD 000 D04 BM - SN: 1386 |
| Calibration procedure(s) | QA CAL-06.v29<br>Calibration procedure for the data acquisition electronics (DAE) |
| 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 ± 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 |
| **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 | i.V. |

Issued: July 20, 2017

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

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

**S** **Schweizerischer Kalibrierdienst**
**C** **Service suisse d'étalonnage**
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**Swiss Calibration Service**

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**Accreditation No.: SCS 0108**

## Glossary

DAE — data acquisition electronics

Connector angle — information used in DASY system to align probe sensor X to the robot coordinate system.

## Methods Applied and Interpretation of Parameters

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

## DC Voltage Measurement

A/D - Converter Resolution nominal

| | | | | |
|---|---|---|---|---|
| High Range: | 1LSB = | 6.1μV , | full range = | -100...+300 mV |
| Low Range: | 1LSB = | 61nV , | full range = | -1.......+3mV |

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

| Calibration Factors | X | Y | Z |
|---|---|---|---|
| **High Range** | 404.509 ± 0.02% (k=2) | 404.603 ± 0.02% (k=2) | 404.122 ± 0.02% (k=2) |
| **Low Range** | 4.02033 ± 1.50% (k=2) | 4.01280 ± 1.50% (k=2) | 4.01256 ± 1.50% (k=2) |

## Connector Angle

| | |
|---|---|
| **Connector Angle** to be used in DASY system | 203.5 ° ± 1 ° |

## Appendix (Additional assessments outside the scope of SCS0108)

### 1. DC Voltage Linearity

| High Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 199994.40 | -0.87 | -0.00 |
| Channel X | + Input | 20001.09 | -0.18 | -0.00 |
| Channel X | - Input | -19999.53 | 1.66 | -0.01 |
| Channel Y | + Input | 199994.93 | -0.61 | -0.00 |
| Channel Y | + Input | 19999.47 | -2.07 | -0.01 |
| Channel Y | - Input | -20000.82 | 0.10 | -0.00 |
| Channel Z | + Input | 199995.00 | -0.63 | -0.00 |
| Channel Z | + Input | 19998.80 | -2.56 | -0.01 |
| Channel Z | - Input | -20001.96 | -0.74 | 0.00 |

| Low Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 2001.10 | -0.11 | -0.01 |
| Channel X | + Input | 201.26 | -0.29 | -0.14 |
| Channel X | - Input | -198.71 | -0.32 | 0.16 |
| Channel Y | + Input | 2001.16 | -0.00 | -0.00 |
| Channel Y | + Input | 201.19 | -0.33 | -0.17 |
| Channel Y | - Input | -199.21 | -0.81 | 0.41 |
| Channel Z | + Input | 2001.08 | 0.00 | 0.00 |
| Channel Z | + Input | 200.18 | -1.28 | -0.64 |
| Channel Z | - Input | -199.68 | -1.29 | 0.65 |

### 2. Common mode sensitivity

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

| | Common mode Input Voltage (mV) | High Range Average Reading (μV) | Low Range Average Reading (μV) |
|---|---|---|---|
| Channel X | 200 | -15.85 | -17.49 |
| | - 200 | 17.99 | 16.50 |
| Channel Y | 200 | -9.26 | -9.27 |
| | - 200 | 8.70 | 7.82 |
| Channel Z | 200 | -5.99 | -5.99 |
| | - 200 | 3.29 | 3.53 |

### 3. Channel separation

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

| | Input Voltage (mV) | Channel X (μV) | Channel Y (μV) | Channel Z (μV) |
|---|---|---|---|---|
| Channel X | 200 | - | 4.71 | -2.87 |
| Channel Y | 200 | 8.35 | - | 6.11 |
| Channel Z | 200 | 8.05 | 6.94 | - |

## 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 | 16015 | 15075 |
| Channel Y | 16073 | 17190 |
| Channel Z | 16065 | 13429 |

## 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

| | Average (μV) | min. Offset (μV) | max. Offset (μV) | Std. Deviation (μV) |
|---|---|---|---|---|
| Channel X | -0.11 | -0.95 | 0.83 | 0.36 |
| Channel Y | 0.05 | -0.80 | 0.87 | 0.39 |
| Channel Z | -0.02 | -1.22 | 0.80 | 0.41 |

## 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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# IMPORTANT NOTICE

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**Shipping of the DAE**: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

**E-Stop Failures**: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

**Repair**: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

**DASY Configuration Files:** Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

**Important Note:**
**Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.**

**Important Note:**
**Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.**

**Important Note:**
**To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.**

Schmid & Partner Engineering

**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** **Sporton (Auden)**

**Certificate No: DAE4-1279_Jan18**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | DAE4 - SD 000 D04 BM - SN: 1279 |
| Calibration procedure(s) | QA CAL-06.v29<br>Calibration procedure for the data acquisition electronics (DAE) |
| Calibration date: | January 03, 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 |
| **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: | Adrian Gehring | Laboratory Technician | A. G. |
| Approved by: | Sven Kühn | Deputy Manager | i.V. |

Issued: January 3, 2018

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

## Glossary

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

## Methods Applied and Interpretation of Parameters

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

## DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

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

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

| Calibration Factors | X | Y | Z |
|---|---|---|---|
| **High Range** | 403.936 ± 0.02% (k=2) | 403.884 ± 0.02% (k=2) | 404.618 ± 0.02% (k=2) |
| **Low Range** | 3.94927 ± 1.50% (k=2) | 3.99010 ± 1.50% (k=2) | 3.98938 ± 1.50% (k=2) |

## Connector Angle

| | |
|---|---|
| **Connector Angle** to be used in DASY system | 354.0 ° ± 1 ° |

## Appendix (Additional assessments outside the scope of SCS0108)

### 1. DC Voltage Linearity

| High Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 199997.64 | 1.92 | 0.00 |
| Channel X | + Input | 20004.80 | 2.86 | 0.01 |
| Channel X | - Input | -19998.76 | 2.17 | -0.01 |
| Channel Y | + Input | 199997.83 | 1.78 | 0.00 |
| Channel Y | + Input | 20003.36 | 1.57 | 0.01 |
| Channel Y | - Input | -20002.72 | -1.82 | 0.01 |
| Channel Z | + Input | 199997.69 | 1.96 | 0.00 |
| Channel Z | + Input | 20001.39 | -0.37 | -0.00 |
| Channel Z | - Input | -20003.42 | -2.35 | 0.01 |

| Low Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 2002.48 | 0.98 | 0.05 |
| Channel X | + Input | 202.86 | 1.08 | 0.53 |
| Channel X | - Input | -196.92 | 1.17 | -0.59 |
| Channel Y | + Input | 2001.79 | 0.30 | 0.02 |
| Channel Y | + Input | 201.96 | 0.09 | 0.04 |
| Channel Y | - Input | -198.07 | 0.01 | -0.00 |
| Channel Z | + Input | 2002.13 | 0.68 | 0.03 |
| Channel Z | + Input | 201.17 | -0.61 | -0.30 |
| Channel Z | - Input | -199.15 | -0.81 | 0.41 |

### 2. Common mode sensitivity

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

| | Common mode Input Voltage (mV) | High Range Average Reading (μV) | Low Range Average Reading (μV) |
|---|---|---|---|
| Channel X | 200 | -18.51 | -19.43 |
| | - 200 | 22.51 | 20.73 |
| Channel Y | 200 | 5.49 | 5.17 |
| | - 200 | -5.84 | -6.15 |
| Channel Z | 200 | 6.57 | 6.24 |
| | - 200 | -7.96 | -7.86 |

### 3. Channel separation

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

| | Input Voltage (mV) | Channel X (μV) | Channel Y (μV) | Channel Z (μV) |
|---|---|---|---|---|
| Channel X | 200 | - | 3.48 | -3.85 |
| Channel Y | 200 | 8.57 | - | 4.96 |
| Channel Z | 200 | 10.34 | 5.90 | - |

## 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** | 15969 | 18140 |
| **Channel Y** | 15962 | 17206 |
| **Channel Z** | 15703 | 15717 |

## 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

| | Average (μV) | min. Offset (μV) | max. Offset (μV) | Std. Deviation (μV) |
|---|---|---|---|---|
| **Channel X** | 1.05 | -0.22 | 2.54 | 0.42 |
| **Channel Y** | -0.28 | -1.59 | 0.65 | 0.42 |
| **Channel Z** | -0.08 | -1.35 | 2.05 | 0.57 |

## 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 |