

# HAC (T-Coil) Test Report

**Application No.:** SUCR2511001121WM  
**Applicant:** TCL Communication Ltd.  
**Address of Applicant:** 5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, NT, Hong Kong  
**Manufacturer:** TCL Communication Ltd.  
**Address of Manufacturer:** 5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, NT, Hong Kong  
**EUT Description:** UMTS/LTE/NR Mobile phone  
**Model No.:** T440R  
**FCC ID:** 2ACCJH201  
**Standards:** ANSI C63.19-2019  
CFR 47 FCC Part 20  
**Date of Receipt:** 2025-11-14  
**Date of Test:** 2025-12-09 to 2025-12-10  
**Date of Issue:** 2025-12-12

|                     |               |
|---------------------|---------------|
| <b>Test Result:</b> | <b>PASS *</b> |
|---------------------|---------------|

\* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <http://www.sgs.com/en/Terms-and-Conditions/Terms-e-Document>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.

**Attention: To check the authenticity of testing / inspection report & certificate, please contact us at telephone:(86-755) 8307 1443, or email: [CN.Doccheck@sgs.com](mailto:CN.Doccheck@sgs.com)**

SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd.  
Wireless Laboratory

South of No. 6 Plant, No. 1, RunSheng Road, Suzhou Industrial Park,  
Suzhou Area, China (Jiangsu) Pilot Free Trade Zone 215000

t (86-512) 6229 2980  
[www.sgsgroup.com.cn](http://www.sgsgroup.com.cn)



| Revision Record |             |            |        |
|-----------------|-------------|------------|--------|
| Version         | Description | Date       | Remark |
| 01              | Original    | 2025-12-12 | /      |

|                          |  |                             |  |  |
|--------------------------|--|-----------------------------|--|--|
| Authorized for issue by: |  |                             |  |  |
|                          |  | Alger Du                    |  |  |
|                          |  | Alger Du / Project Engineer |  |  |
|                          |  | Leon Liu                    |  |  |
|                          |  | Leon Liu / Reviewer         |  |  |

## TEST SUMMARY

| Frequency Band    | HAC T-coil Test Results |
|-------------------|-------------------------|
| WCDMA Band II     | PASS                    |
| WCDMA Band IV     | PASS                    |
| WCDMA Band V      | PASS                    |
| LTE band 2        | PASS                    |
| LTE band 4        | PASS                    |
| LTE band 5        | PASS                    |
| LTE band 7        | PASS                    |
| LTE band 12       | PASS                    |
| LTE band 14       | PASS                    |
| LTE band 66       | PASS                    |
| FR1 n2            | PASS                    |
| FR1 n5            | PASS                    |
| FR1 n14           | PASS                    |
| FR1 n66           | PASS                    |
| FR1 n77           | PASS                    |
| WLAN2.4GHz        | PASS                    |
| WLAN5GHz          | PASS                    |
| HAC Results: PASS |                         |

### Remark:

This test report (Report No.: SUCR251100112101 issue on 2025-12-12) is based on the original test report (Report No.: SUCR250900093001 issue on 2025-10-17).

Review this report and original report, this report just changing the parts according to the declaration letter from client.

Considering to the difference, pre-scan were performed on the sample in this report to find the items which can be influential to the result in the original test report for fully retest.

Therefore in this report added WCDMA Band IV, LTE Band 7/14 and NR Band n14 data and disabled the GSM/LTE B13/LTE B48/NR N48 bands were performed based on the original report with report number SUCR250900093001 issue on 2025-10-17 and other test data in this report are refer to the previous report with report number SUCR250900093001 issue on 2025-10-17.

Please refer to section 6.2 and 7.1 of the report for the experimental values of this experiment.

## CONTENTS

|           |                                                     |           |
|-----------|-----------------------------------------------------|-----------|
| <b>1</b>  | <b>General Information .....</b>                    | <b>5</b>  |
| 1.1       | Introduction.....                                   | 5         |
| 1.2       | Test Location.....                                  | 6         |
| 1.3       | Test Facility .....                                 | 6         |
| 1.4       | General Description of EUT .....                    | 7         |
| 1.4.1     | DUT Antenna Locations.....                          | 9         |
| 1.4.2     | List of air interfaces/frequency bands.....         | 10        |
| 1.5       | Test Specification .....                            | 11        |
| 1.6       | ANSI C63.19-2019 limits .....                       | 11        |
| <b>2</b>  | <b>Environmental Conditions.....</b>                | <b>12</b> |
| <b>3</b>  | <b>HAC (T-Coil) Measurement System .....</b>        | <b>13</b> |
| 3.1       | Measurement System Diagram for SPEAG Robotic .....  | 13        |
| 3.2       | T-Coil Measurement .....                            | 14        |
| 3.3       | System Calibration .....                            | 19        |
| 3.4       | Audio Magnetic Probe AM1DV3 .....                   | 20        |
| 3.5       | Test Arch.....                                      | 20        |
| 3.6       | Phone Holder .....                                  | 20        |
| 3.7       | AMCC- Audio Magnetic Calibration Coil .....         | 21        |
| 3.8       | AMMI - Audio Magnetic Measurement Instrument .....  | 21        |
| <b>4</b>  | <b>Measurement uncertainty evaluation.....</b>      | <b>22</b> |
| <b>5</b>  | <b>HAC (T-Coil) Measurement .....</b>               | <b>23</b> |
| 5.1       | T-Coil Performance Requirements .....               | 23        |
| 5.2       | T-Coil measurement points and reference plane ..... | 25        |
| 5.3       | T-Coil Measurement Procedure.....                   | 26        |
| <b>6</b>  | <b>T-Coil testing for CMRS Voice.....</b>           | <b>27</b> |
| 6.1       | General Description.....                            | 27        |
| 6.2       | UMTS Tests Results.....                             | 27        |
| <b>7</b>  | <b>T-Coil testing for CMRS IP Voice .....</b>       | <b>28</b> |
| 7.1       | VoLTE and VoNR Tests Results.....                   | 28        |
| <b>8</b>  | <b>Equipment list .....</b>                         | <b>29</b> |
| <b>9</b>  | <b>Calibration certificate.....</b>                 | <b>30</b> |
| <b>10</b> | <b>Photographs .....</b>                            | <b>30</b> |
|           | <b>Appendix A: Detailed Test Results .....</b>      | <b>30</b> |
|           | <b>Appendix B: Calibration certificate.....</b>     | <b>30</b> |
|           | <b>Appendix C: Photographs .....</b>                | <b>30</b> |

# 1 General Information

## 1.1 Introduction

The purpose of this standard is to provide tests and establish requirements for hearing aids and for WDs that allow a hearing aid user to effectively use a WD when both the hearing aid and WD meet the requirements of this standard. The various parameters required in order to demonstrate compatibility are measured. The design of the standard is such that when a hearing aid and a WD achieve the specified requirements, as measured by the methodology of this standard, the user of a hearing aid can effectively use a WD In order to provide for the usability of a hearing aid with a WD, several factors are coordinated, as follows:

- a) The field strength emitted by a WD must not exceed the RF immunity of the hearing aid.
- b) The T-Coil baseband H-field transmission of the WD must be compatible with the T-Coil mode of the hearing aid.
- c) The magnetic noise from the WD in the T-Coil band must not degrade the reception quality to unacceptable levels.

Both the WD's RF and audio-band emissions are measured. Hence, the following measurements are made for the WDs:

- a) RF amplitude modulation characteristics and power level or, optionally, near-field E-field emissions
- b) T-Coil mode, magnetic signal strength in the audio band.
- c) T-Coil mode, magnetic noise in the audio band
- d) T-Coil mode, magnetic signal frequency response in the audio band

Corresponding to these quantities, the hearing aid is measured for the following:

- 1) RF immunity in microphone mode
- 2) RF immunity in T-Coil mode

## 1.2 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd.

South of No. 6 Plant, No. 1, Runsheng Road, Suzhou Industrial Park, Suzhou Area, China (Jiangsu) Pilot Free Trade Zone

No tests were sub-contracted.

## 1.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **A2LA (Certificate No. 6336.01)**

SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA).

- **FCC (Designation Number: CN1312)**

SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd. has been recognized as an accredited testing laboratory.

- **ISED (CAB Identifier: CN0120)**

SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd. has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory.

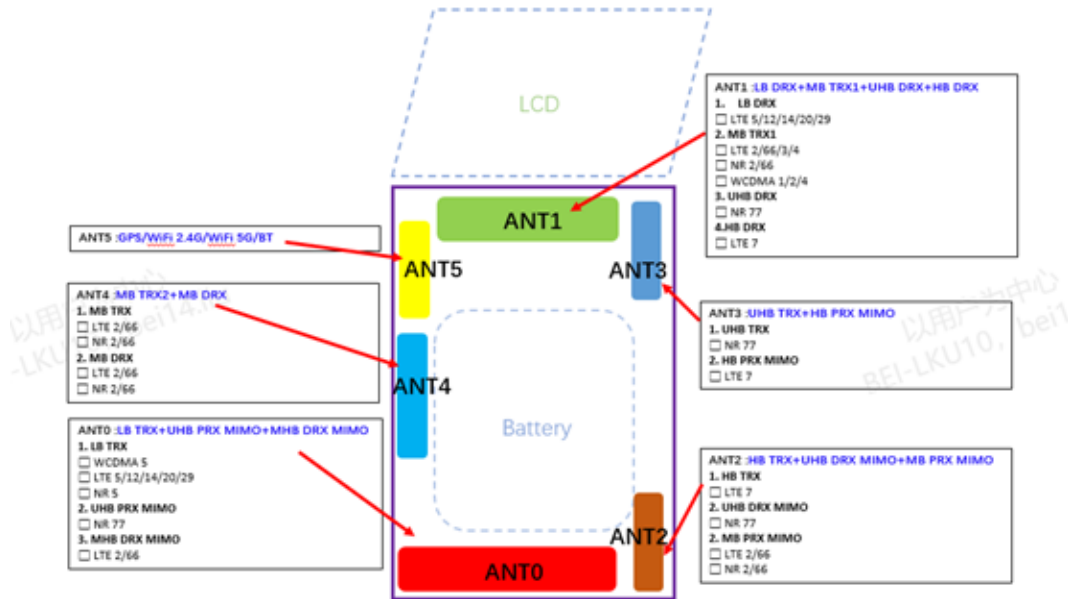
Company Number: 27594

## 1.4 General Description of EUT

|                             |                                                     |                          |   |
|-----------------------------|-----------------------------------------------------|--------------------------|---|
| <b>Device Type:</b>         | portable device                                     |                          |   |
| <b>Exposure Category:</b>   | uncontrolled environment / general population       |                          |   |
| <b>Product Name:</b>        | UMTS/LTE/NR Mobile phone                            |                          |   |
| <b>Model No.(EUT):</b>      | T440R                                               |                          |   |
| <b>Product Phase:</b>       | Identical Prototype                                 |                          |   |
| <b>IMEI:</b>                | 016771000006906/016771000006963                     |                          |   |
| <b>Hardware Version:</b>    | 04                                                  |                          |   |
| <b>Software Version:</b>    | vBR4A                                               |                          |   |
| <b>Antenna Type:</b>        | FPC Antenna                                         |                          |   |
| <b>Modulation Mode:</b>     | WCDMA: QPSK,16QAM;                                  |                          |   |
|                             | LTE: QPSK,16QAM,64QAM,256QAM;                       |                          |   |
|                             | NR: BPSK,QPSK,16QAM,64QAM,256QAM,DFT-s-OFDM,CP-OFDM |                          |   |
|                             | WIFI: DSSS, OFDM; BT: GFSK, $\pi/4$ DQPSK,8DPSK     |                          |   |
| <b>HSDPA UE Category:</b>   | 24                                                  | <b>HSUPA UE Category</b> | 7 |
| <b>Power Class</b>          | 3, tested with power control "all 1"(WCDMA Band)    |                          |   |
|                             | 3, tested with power control Max Power(LTE Band)    |                          |   |
| <b>Frequency Bands:</b>     | Band                                                | Tx (MHz)                 |   |
|                             | WCDMA Band II                                       | 1850~1910                |   |
|                             | WCDMA Band IV                                       | 1710~1755                |   |
|                             | WCDMA Band V                                        | 824~849                  |   |
|                             | LTE band 2                                          | 1850~1910                |   |
|                             | LTE band 4                                          | 1710~1755                |   |
|                             | LTE band 5                                          | 824~849                  |   |
|                             | LTE band 7                                          | 2500~2570                |   |
|                             | LTE band 12                                         | 699~716                  |   |
|                             | LTE band 14                                         | 788~798                  |   |
|                             | LTE band 66                                         | 1710~1780                |   |
|                             | NR Band n2                                          | 1850~1910                |   |
|                             | NR Band n5                                          | 824~849                  |   |
|                             | NR Band n14                                         | 788~798                  |   |
|                             | NR Band n66                                         | 1710~1780                |   |
|                             | NR Band n77                                         | 3450~3550                |   |
|                             |                                                     | 3700~3980                |   |
|                             |                                                     |                          |   |
|                             |                                                     |                          |   |
|                             | WLAN2.4GHz                                          | 2412~2472                |   |
|                             | WLAN5GHz                                            | 5180~5240                |   |
|                             |                                                     | 5260~5320                |   |
|                             |                                                     | 5500~5720                |   |
|                             |                                                     | 5745~5825                |   |
|                             | Bluetooth                                           | 2402~2480                |   |
| <b>Battery Information:</b> | Model:                                              | TLp029M9                 |   |
|                             | Normal Voltage:                                     | 3.87V                    |   |

|                                                                                                                                                                                                                                                                                                                              |                 |                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------------|
|                                                                                                                                                                                                                                                                                                                              | Rated capacity: | 3000mAh/11.61Wh                       |
|                                                                                                                                                                                                                                                                                                                              | Manufacturer1:  | Guangdong Fenghua New Energy Co.,Ltd. |
|                                                                                                                                                                                                                                                                                                                              | Model:          | TLp029M7                              |
|                                                                                                                                                                                                                                                                                                                              | Normal Voltage: | 3.87V                                 |
|                                                                                                                                                                                                                                                                                                                              | Rated capacity: | 3000mAh/11.61Wh                       |
|                                                                                                                                                                                                                                                                                                                              | Manufacturer1:  | Dongguan Veken Battery Co. ,Ltd.      |
| <p>Note:</p> <p>*Since the above data and/or information is provided by the client relevant results or conclusions of this report are only made for these data and/or information, SGS is not responsible for the authenticity, integrity and results of the data and information and/or the validity of the conclusion.</p> |                 |                                       |

## 1.4.1 DUT Antenna Locations



### 1.4.2 List of air interfaces/frequency bands

| Air Interface | Band (MHz)  | Type | ANSI C63.19 | Simultaneous Transmitter | Name of Voice Service | Power Reduction |
|---------------|-------------|------|-------------|--------------------------|-----------------------|-----------------|
|               |             |      | Tested      |                          |                       |                 |
| WCDMA         | Band II     | VO   | Yes         | BT, Wi-Fi                | CMRS Voice            | NO              |
|               | Band IV     |      |             |                          |                       |                 |
|               | Band V      |      |             |                          |                       |                 |
| LTE FDD       | LTE band 2  | VO   | Yes         | BT, Wi-Fi                | VoLTE                 | NO              |
|               | LTE band 4  |      |             |                          |                       |                 |
|               | LTE band 5  |      |             |                          |                       |                 |
|               | LTE band 7  |      |             |                          |                       |                 |
|               | LTE band 12 |      |             |                          |                       |                 |
|               | LTE band 14 |      |             |                          |                       |                 |
|               | LTE band 66 |      |             |                          |                       |                 |
| FR1 FDD       | FR1 n2      | VO   | Yes         | BT, Wi-Fi                | VoNR                  | NO              |
|               | FR1 n5      |      |             |                          |                       |                 |
|               | FR1 n14     |      |             |                          |                       |                 |
|               | FR1 n66     |      |             |                          |                       |                 |
| FR1 TDD       | FR1 n77     | VO   | Yes         | BT, Wi-Fi                | VoNR                  | NO              |
| Wi-Fi         | 2437        | VO   | Yes         | WWAN                     | VoWiFi                | NO              |
|               | 5190        |      |             |                          |                       |                 |
|               | 5200        |      |             |                          |                       |                 |
|               | 5210        |      |             |                          |                       |                 |
|               | 5300        |      |             |                          |                       |                 |
|               | 5580        |      |             |                          |                       |                 |
|               | 5785        |      |             |                          |                       |                 |
| BT            | 2437        | DT   | No(1)       | WWAN                     | NA                    | NO              |

VO: Legacy Cellular Voice Service

DT: Digital Transport (no voice)

VD: IP Voice Service over Digital Transport

\*ANSI C63.19-2019 use table 6.1 to establish the Normal speech input level and NOTE 2 of table 6.1 identifies the group of VoIP voice services that use -16 dBm0 as the normal speech input level.

Remark:

1. Because features of Google Meet allow the option of voice-only communications, Meet has been tested for HAC/T-Coil compatibility to ensure the best user experience.

2. The Google Meet and google Fi the audio path, parameter and audio codec are all the same, therefore, the Google Meet is evaluation for this device to show compliance.

## 1.5 Test Specification

| Identity           | Document Title                                                                                                |
|--------------------|---------------------------------------------------------------------------------------------------------------|
| CFR 47 FCC Part 20 | §20.19 Hearing aid-compatible mobile handsets.                                                                |
| ANSI C63.19-2019   | American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices |
| KDB 285076 D01     | HAC Guidance v06r04                                                                                           |
| KDB 285076 D02     | T-Coil testing v04                                                                                            |

## 1.6 ANSI C63.19-2019 limits

GSM operating modes:

- The primary group shall include at least 25 measurement points.
- The secondary group shall include at least 125 contiguous measurement points.

Non-2G GSM operating modes:

- The primary group shall include at least 75 measurement points.
- The secondary group shall include at least 300 contiguous measurement points

Additionally, to avoid an oddly shaped area of low noise, the secondary group shall include at least one longitudinal column of at least 10 contiguous qualifying points and at least one transverse row containing at least 15 contiguous qualifying points.

## 2 Environmental Conditions

|                   |                           |
|-------------------|---------------------------|
| Temperature       | Min. = 18°C, Max. = 25 °C |
| Relative humidity | Min. = 30%, Max. = 70%    |

Table 1: The Ambient Conditions

### 3 HAC (T-Coil) Measurement System

### 3.1 Measurement System Diagram for SPEAG Robotic

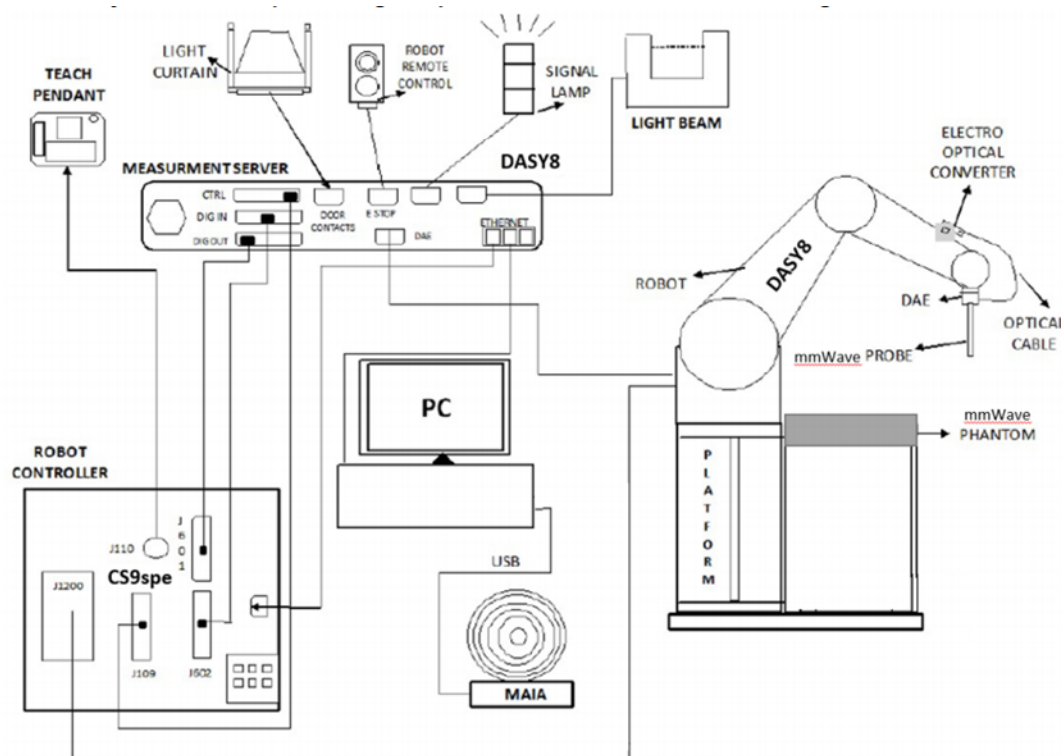


Fig. 1. The SPEAG Robotic Diagram

The DASY system for performing compliance tests consists of the following items:

- The DASY system for performing compliance tests consists of the following items:
- A standard high precision 6-axis robot (Stabile RX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
- An Audio Magnetic probe.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows system.
- DASY software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The Test Arch SAM phantom
- The device holder for handheld mobile phones.
- Validation dipole kits allowing to validate the proper functioning of the system.

## 3.2 T-Coil Measurement

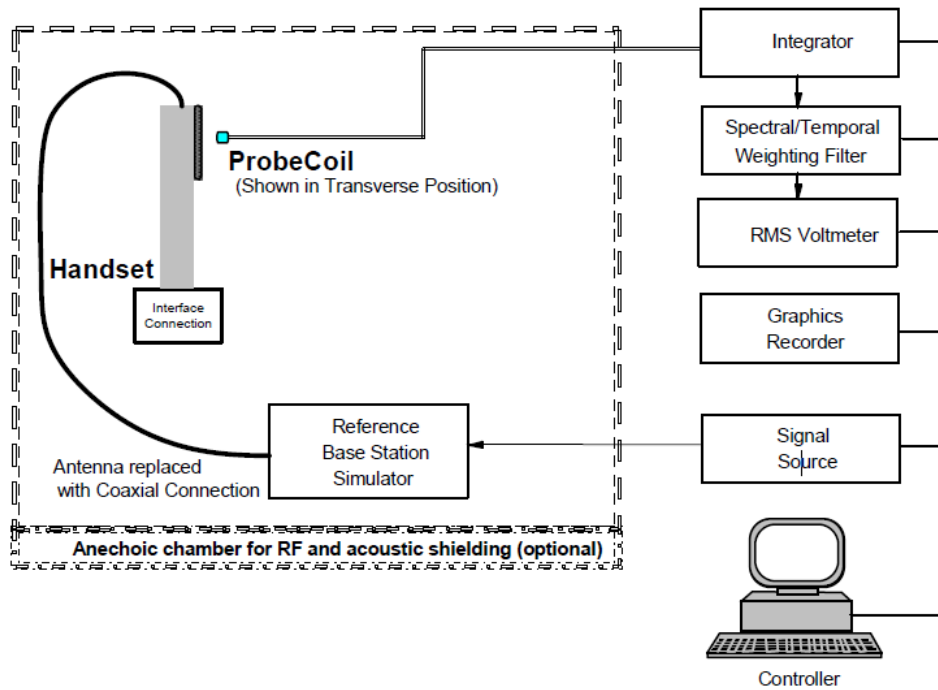


Fig. 2. T-coil signal measurement test setup-in call method

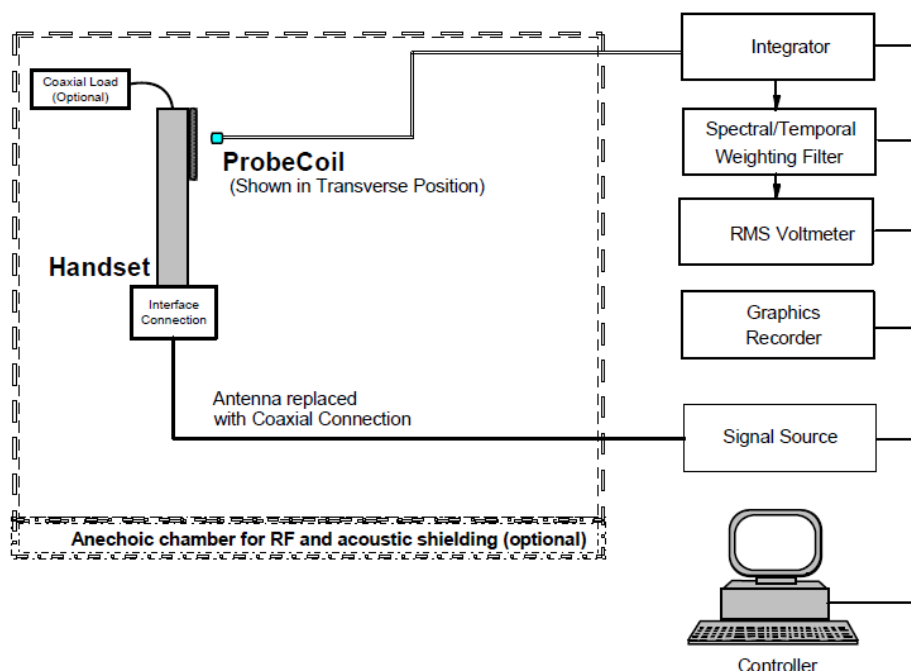


Fig. 3. T-coil signal measurement test setup-test mode method.

The reference axis is normal to the reference plane and passes through the center of the acoustic output (or the center of the whole array); or may be centered on or near a secondary inductive source. The actual location of the reference axis and resultant measurement area shall be noted in the test report.

The measurement area shall be 50 mm by 50 mm. The measurement area for both desired ABM signal and undesired ABM field may be located where the transverse magnetic measurements are optimum with regard to the requirements. However, the measurement area should be in the vicinity of the acoustic output of the WD and shall be in the same half of the phone as the WD receiver. In a WD handset with a centered receiver and a circularly symmetrical magnetic field, the measurement axis and the reference axis would coincide.

Measurements of desired ABM signal strength and undesired ABM field are made at 2.0 mm  $\pm$  0.5 mm or 4 mm intervals in an X-Y measurement area pattern over the entire measurement area (676 measurement points total); either all measured or measured plus interpolated.

#### Note.

#. The EUT do not use the special HAC SW.

#. Setting the maximum volume for EUT during the measurement.

#. For the measurement, it doesn't use the "post-test measurement processing of results".

#. Per KDB 285076 D01 v06r04, handsets that have the ability to support concurrent connections using simultaneous transmissions shall be independently tested for each air interface/band given in ANSI C63.19-2019. At the present time ANSI C63.19 does not provide simultaneous transmission test procedures.

# Define the all applicable input audio level as below according to c63 and KDB 285076 D02v04:

GSM input Level: -16dB

UMTS input Level: -16dB

VOLTE input Level: -16dB

VOWIFI input Level: -16dB

VONR input Level: -16dB

OTT input Level: -16dB

# For GSM/UMTS/VoLTE/VOWIF test setup and input level, the correct input level definition is via a communication tester CMW500 "Decoder Cal" and "Codec Cal" to set the correct audio input levels.

# For VONR test setup and input level, the correct input level definition is via a communication tester CMX500 and External DAU USB sound card "Decoder Cal" and "Codec Cal" to set the correct audio input levels.

# CMW500 and External DAU USB sound card is able to output 1 kHz audio signal equivalent to 3.14dBm0 at "Decoder Cal". configuration, the signal reference is used to adjust the AMMI gain setting to reach -16Bm0 for GSM/UMTS/VoLTE/VONR. CMW500/CMX500 input is calibrated and the relation between the analog input voltage and the internal level in dBm0 can be determined.

### 3.2.1 Define the input level for GSM/UMTS/LTE/WLAN

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.

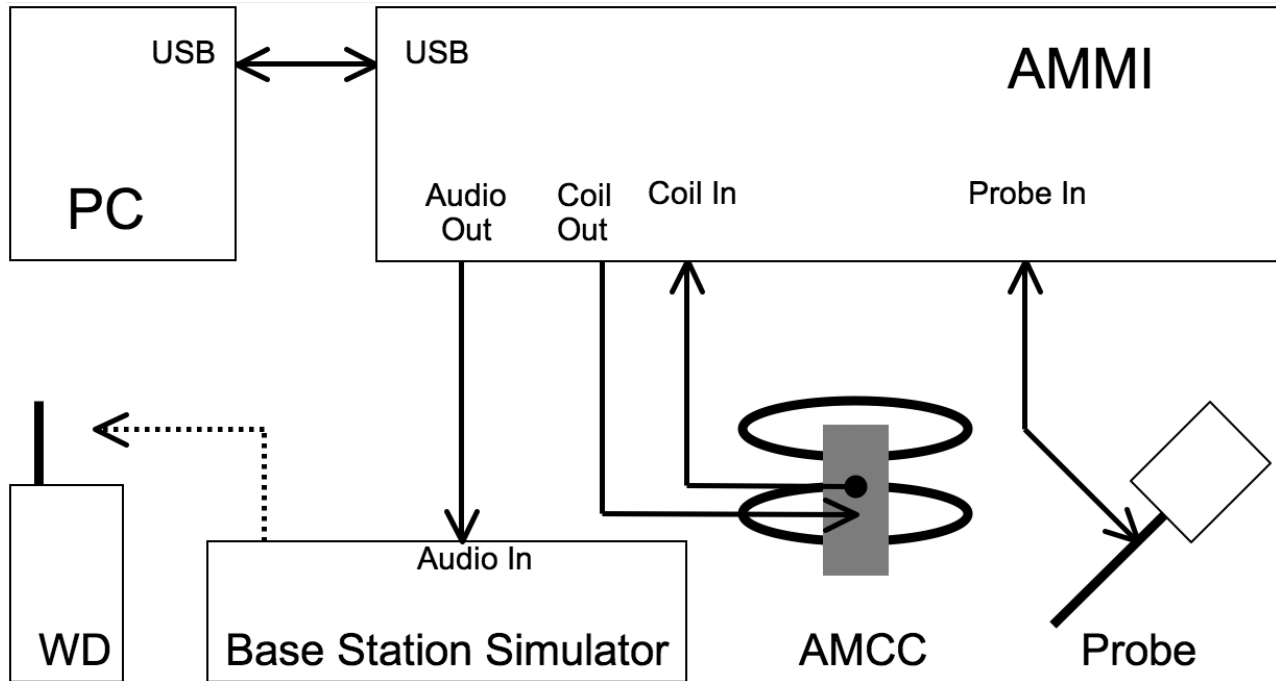


Fig. 2. T-coil signal measurement test setup

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

| Signal<br>[file name]         | Duration<br>[s] | Peak-to-RMS<br>[dB] | RMS<br>[dB] | Required gain<br>factor *) | Gain<br>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 achieve approx. the same level as for the 1kHz sine signal.

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

## Input Level for GSM/UMTS/VoLTE/VOWIFI

| Gain Value         | dBm0          | Full scal Voltage | dB       | AMMI audio out dBv (RMS) | AMCC Coil Out (dBv (RMS) |
|--------------------|---------------|-------------------|----------|--------------------------|--------------------------|
|                    | 3.14          | 1.5               |          | 0.55                     |                          |
| 100                | 5.53          |                   | 40       | 2.94                     | 3.09                     |
| 8.39               | -16           |                   | 18.47    |                          | -18.44                   |
| Signal Type        | Duratio n (s) | Peak to RMS (dB)  | RMS (dB) | Gain Factor              | Gain Setting             |
| 1kHz sine          | -             | 3                 | 0        | 1                        | 8.39                     |
| 48k_voice_1kHz     | 1             | 15.74             | -12.7    | 4.33                     | 36.32                    |
| 48k_voice_300-3000 | 2             | 21.57             | -18.6    | 8.48                     | 71.13                    |

## Define the input level for OTT.

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.

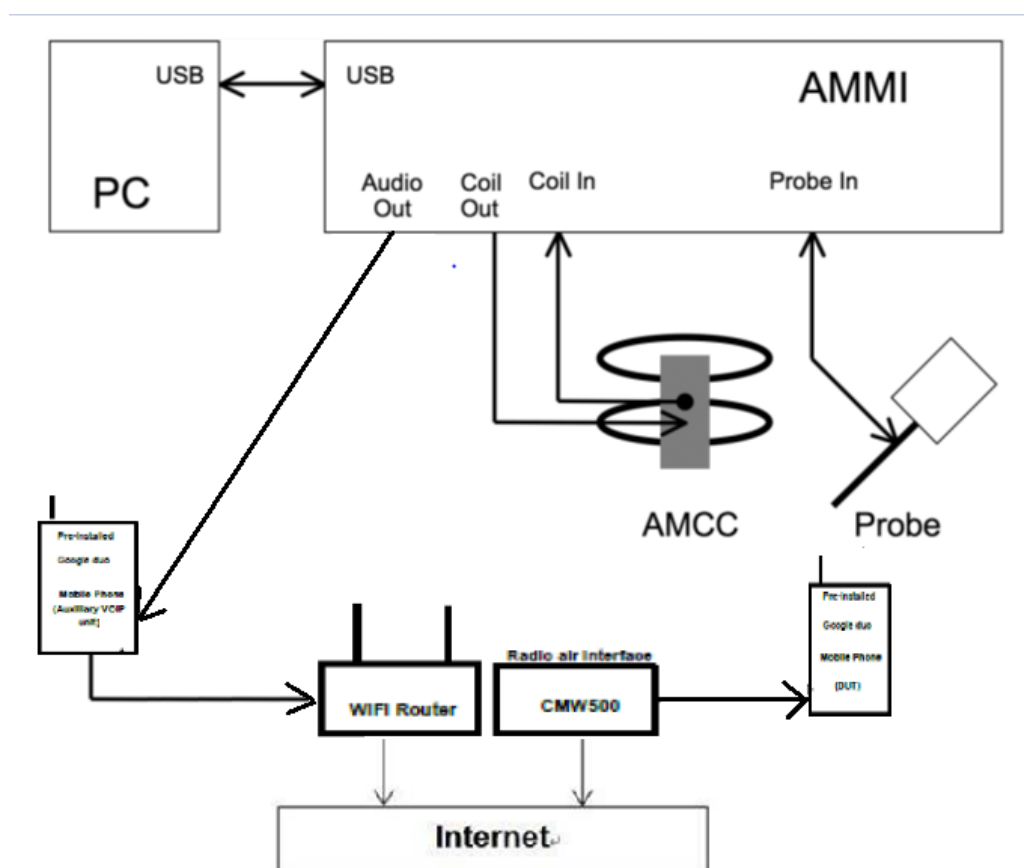


Fig. 2. T-coil signal measurement test setup

- #. Voice over Internet Protocol (VoIP) such as Google Meet application, also called IP telephony, is a methodology and group of technologies for the delivery of voice communications and multimedia sessions over Internet Protocol (IP) networks, such as the Internet. The terms Internet telephony, broadband telephony, and broadband phone service specifically refer to the provisioning of communications services (voice, fax, SMS, voice-messaging) over the public Internet, rather than via the public switched telephone network (PSTN)
- #. The Google Meet service support code and bitrate are list in section9, the customized Google Meet software is installed on a mobile phone which is used as the Auxiliary for the test. The software enables audio coding rate to be changed, and reports the input digital audio level before audio processing which can be used to calibrate the input audio level
- ..#. This device comes with the preinstalled VoIP application that supports the Google Meet service and related codec. The test configuration establishes a call between the device under test and an auxiliary handset via the Google Meet server
- #. The test setup used for Google Meet VoIP call is via the data application unit on the 2G/3G/4G/5G/WiFi simulate base station, connected to the internet via the Google Meet server to the auxiliary device. The auxiliary device runs special software that allows the codecs and bit rate to be fixed to a specific value. Please refer to section9, an assessment was made of each of the different codec bit rates to determine the worst case for each of the different OTT transport (WiFi, LTE, GSM, WCDMA,NR)
- #. The auxiliary device includes software that displays the audio level in dBFS which allows calibration of the system to establish the -16dBm0 reference level. After establishing the voice call between auxiliary device and device under test the audio output from the AMMI is injected into the auxiliary device. The gain factor to establish a reference level of -16dBm0 for use during the test is determined as detailed in the next page based on the 0dBFull Scale (0dBFS) value being equivalent to 3.14dBm0.

#### Input Level for OTT

| Gain Value         | 20* log(gain) | AMCC Coil Out    |          |             | Level        |
|--------------------|---------------|------------------|----------|-------------|--------------|
| (linear)           | dB            | (dBv RMS)        |          |             | dBm0         |
|                    |               | 0.533            |          |             | 3.14         |
| 10                 | 20            | -18.39           |          |             | -15.78       |
| 9.75               | 19.78         | -22.61           |          |             | -16          |
| Signal Type        | Duration (s)  | Peak to RMS (dB) | RMS (dB) | Gain Factor | Gain Setting |
| 1kHz sine          | -             | 3                | 0        | 1           | 9.75         |
| 48k_voice_1kHz     | 1             | 15.74            | -12.7    | 4.33        | 42.23        |
| 48k_voice_300-3000 | 2             | 21.57            | -18.6    | 8.48        | 82.71        |

### 3.3 System Calibration

For correct and calibrated measurement of the voltages and ABM field, DASY will perform a calibration job as below.

In phase 1, the audio output is switched off, and a 200 mVpp symmetric rectangular signal of 1 kHz is generated and internally connected directly to both channels of the sampling unit (Coil in, Probe in).

In phase 2, the audio output is off, and a 20 mVpp symmetric 100 Hz signal is internally connected. The signals during phases 1 and 2 are available at the output on the rear panel of the AMMI. However, the output must not be loaded, in order to avoid influencing the calibration. An RMS voltmeter would indicate 100 mVRMS during the first phase and 10 mVRMS during the second phase. After the first two phases, the two input channels are both calibrated for absolute measurements of voltages. The resulting factors are displayed above the multi-meter window.

After phases 1 and 2, the input channels are calibrated to measure exact voltages. This is required to use the inputs for measuring voltages with their peak and RMS value.

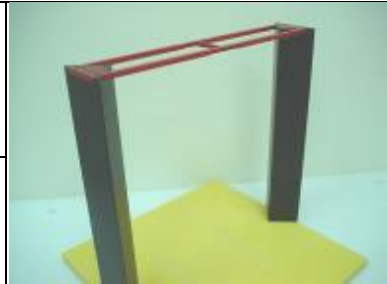
In phase 3, a multi-sine signal covering each third-octave band from 50 Hz to 10 kHz is generated and applied to both audio outputs. The probe should be positioned in the center of the AMCC and aligned in the z-direction, the field orientation of the AMCC. The “Coil In” channel is measuring the voltage over the AMCC internal shunt, which is proportional to the magnetic field in the AMCC. At the same time, the “Probe In” channel samples the amplified

signal picked up by the probe coil and provides it to a numerical integrator. The ratio of the two voltages in each third-octave filter leads to the spectral representation over the frequency band of interest. The Coil signal is scaled in dBV, and the Probe signal is first integrated and normalized to show dB A/m. The ratio probe-to-coil at the frequency of 1 kHz is the sensitivity which will be used in the consecutive T-Coil jobs.

## 3.4 Audio Magnetic Probe AM1DV3

|               |                                                                                                                                        |                                                                                                          |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Description   | Active single sensor probe for both axial and radial measurement scans- Fully RF shielded, compatible with DAE, with adapted probe cup | <br>AM1DV3 Audio Probe |
| Dynamic Range | 0.1 KHz to 20 KHz                                                                                                                      |                                                                                                          |
| Sensitivity   | <-50dB A/m @ 1KHz                                                                                                                      |                                                                                                          |
| Internal Amp  | 20dB                                                                                                                                   |                                                                                                          |
| Dimensions    | 300X18mm                                                                                                                               |                                                                                                          |

## 3.5 Test Arch

|             |                                                                                                                        |                                                                                                  |
|-------------|------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| Description | Enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot. | <br>Test Arch |
| Dimensions  | length: 370 mm<br>width: 370 mm<br>height: 370 mm                                                                      |                                                                                                  |

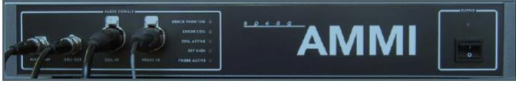
## 3.6 Phone Holder

|             |                                                                                          |                                                                                                       |
|-------------|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Description | Supports accurate and reliable positioning of any phone Effect on near field <+/- 0.5 dB | <br>Phone Holder |
|-------------|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|

## 3.7 AMCC- Audio Magnetic Calibration Coil

|             |                                                                                                                                                                                         |                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Description | Allows calibration of the complete measurement setup, the two horizontal coils create a homogeneous magnetic field in the z direction. Refer to Appendix 5 for more detail on AMCC coil |  <p>AMCC</p> |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|

## 3.8 AMMI - Audio Magnetic Measurement Instrument

|               |                                                                                                                                                                                                                       |                                                                                                |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Description   | -USB interface to PC<br>- Probe signal digitization and power supply- Test signal generation for wireless device (via base station simulator)- Auto-calibration and interfaces to AMCC for complete setup-calibration |  <p>AMMI</p> |
| Data Rate     | 48 KHz / 24bit                                                                                                                                                                                                        |                                                                                                |
| Dynamic Range | 85 dB                                                                                                                                                                                                                 |                                                                                                |
| Dimensions:   | 19" X 65 X 270mm                                                                                                                                                                                                      |                                                                                                |

## 4 Measurement uncertainty evaluation

| Error Description                     | Uncertainty Value (%)                       | Probability Dist. | Divisor    | ci ABM1 | ci ABM2 | Standard Uncertainty ABM1 (%) | Standard Uncertainty ABM2 (%) |
|---------------------------------------|---------------------------------------------|-------------------|------------|---------|---------|-------------------------------|-------------------------------|
| <b>Related to probe sensitivity</b>   |                                             |                   |            |         |         |                               |                               |
| Reference level                       | ±3.0                                        | R                 | $\sqrt{3}$ | 1       | 1       | ±3.0                          | ±3.0                          |
| AMCC geometry                         | ±0.4                                        | R                 | $\sqrt{3}$ | 1       | 1       | ±0.2                          | ±0.2                          |
| AMCC current                          | ±0.6                                        | R                 | $\sqrt{3}$ | 1       | 1       | ±0.4                          | ±0.4                          |
| Probe positioning during calibration  | ±0.2                                        | R                 | $\sqrt{3}$ | 1       | 1       | ±0.1                          | ±0.1                          |
| Noise distribution                    | ±0.7                                        | R                 | $\sqrt{3}$ | 0.0143  | 1       | ±0.0                          | ±0.4                          |
| Frequency slope                       | ±5.9                                        | R                 | $\sqrt{3}$ | 0.1     | 1       | ±0.3                          | ±3.5                          |
| <b>Related to probe system</b>        |                                             |                   |            |         |         |                               |                               |
| Repeatability / drift                 | ±1.0                                        | R                 | $\sqrt{3}$ | 1       | 1       | ±0.6                          | ±0.6                          |
| Linearity / dynamic range             | ±0.6                                        | N                 | 1          | 1       | 1       | ±0.4                          | ±0.4                          |
| Audio noise                           | ±1.0                                        | R                 | $\sqrt{3}$ | 0.1     | 1       | ±0.1                          | ±0.6                          |
| Probe angle                           | ±2.3                                        | R                 | $\sqrt{3}$ | 1       | 1       | ±1.4                          | ±1.4                          |
| Spectral Processing                   | ±0.9                                        | R                 | $\sqrt{3}$ | 1       | 1       | ±0.5                          | ±0.5                          |
| Integration time                      | ±0.6                                        | N                 | 1          | 1       | 5       | ±0.6                          | ±3.0                          |
| Field distribution                    | ±0.2                                        | R                 | $\sqrt{3}$ | 1       | 1       | ±0.1                          | ±0.1                          |
| <b>Test signal</b>                    |                                             |                   |            |         |         |                               |                               |
| Reference signal spectrum response    | ±0.6                                        | R                 | $\sqrt{3}$ | 0       | 1       | ±0.0                          | ±0.4                          |
| <b>Positioning</b>                    |                                             |                   |            |         |         |                               |                               |
| Probe positioning                     | ±1.9                                        | R                 | $\sqrt{3}$ | 1       | 1       | ±1.1                          | ±1.1                          |
| Phantom Thickness                     | ±0.9                                        | R                 | $\sqrt{3}$ | 1       | 1       | ±0.5                          | ±0.5                          |
| DUT positioning                       | ±1.9                                        | R                 | $\sqrt{3}$ | 1       | 1       | ±1.1                          | ±1.1                          |
| <b>External Contributions</b>         |                                             |                   |            |         |         |                               |                               |
| RF interference                       | ±0.0                                        | R                 | $\sqrt{3}$ | 1       | 0.3     | ±0.0                          | ±0.0                          |
| Test Signal Variation                 | ±2.0                                        | R                 | $\sqrt{3}$ | 1       | 1       | ±1.2                          | ±1.2                          |
| Combined Std. Uncertainty (ABM Field) | $u_c' = \sqrt{\sum_{i=1}^{20} c_i^2 u_i^2}$ |                   |            |         |         | ±4.1                          | ±6.2                          |
| Expanded Std. Uncertainty (K=2)       |                                             |                   |            |         |         | ±8.2                          | ±12.4                         |

Table 2: Measurement uncertainties for T-Coil

## 5 HAC (T-Coil) Measurement

### 5.1 T-Coil Performance Requirements

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

#### 1) T-Coil coupling field intensity

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

#### 2) Frequency response

The frequency response of the axial component of the magnetic field, measured in 1/3 octave bands, shall follow the response curve specified in this sub-clause, over the frequency range 300 Hz to 3000 Hz. Figure 1 and Figure 2 provide the boundaries for the specified frequency.

These response curves are for true field strength measurements of the T-Coil signal. Thus the 6 dB/octave probe response has been corrected from the raw readings.

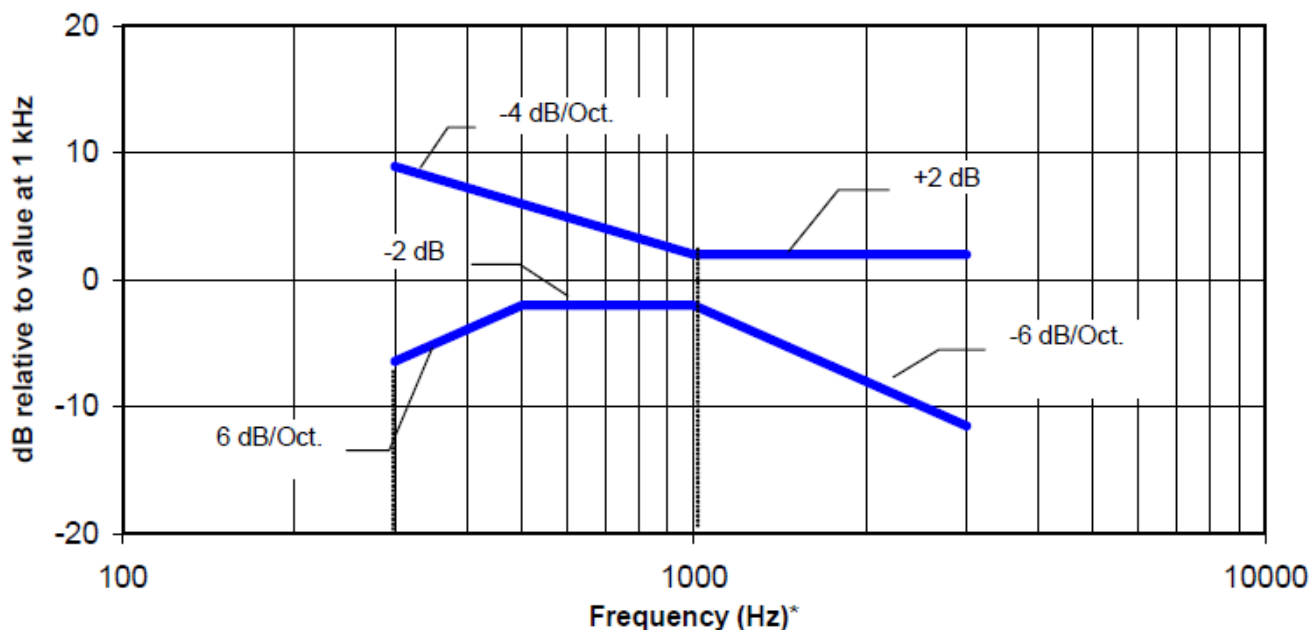


Figure 1—Magnetic field frequency response for WDs with a field  $\leq -15$  dB (A/m) at 1 kHz

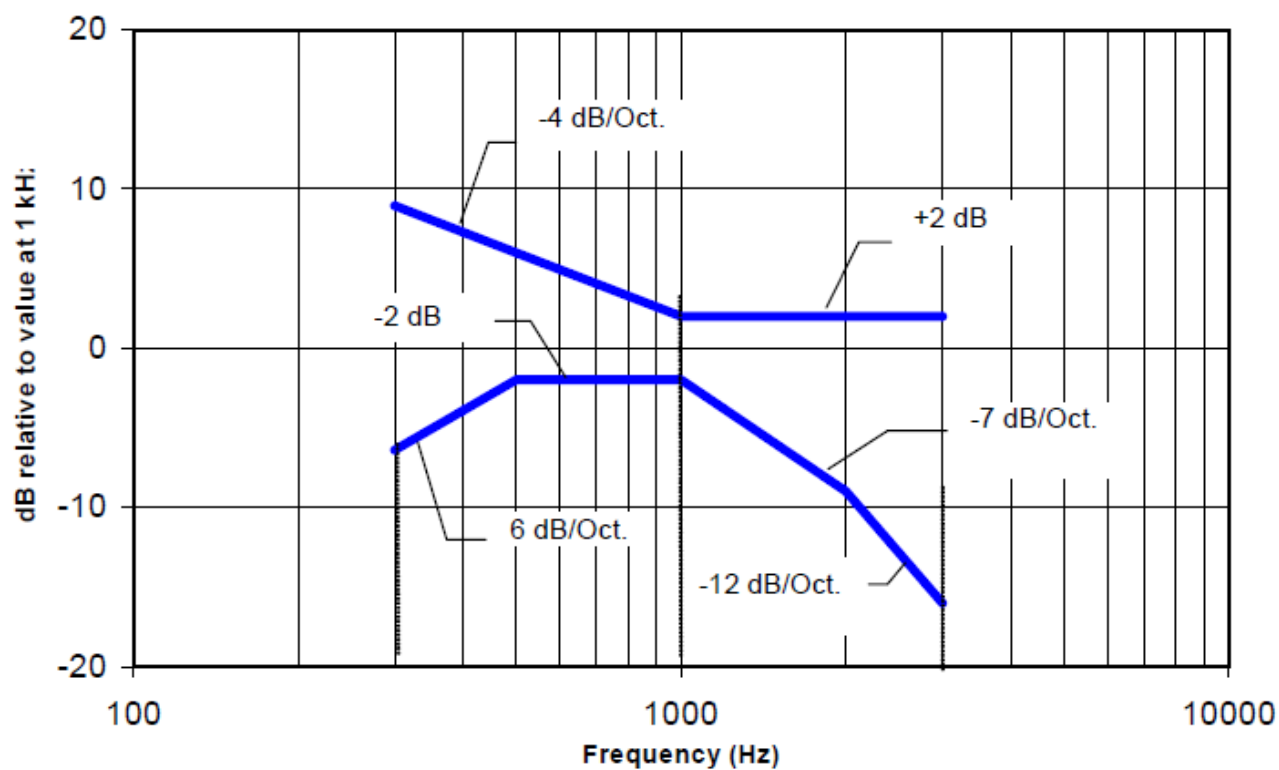


Figure 2 —Magnetic field frequency response for WDs with a field that exceeds -15dB(A/m) at 1 kHz

## 5.2 T-Coil measurement points and reference plane

Figure 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.

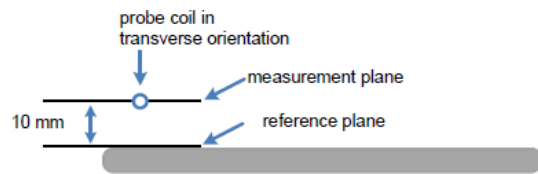
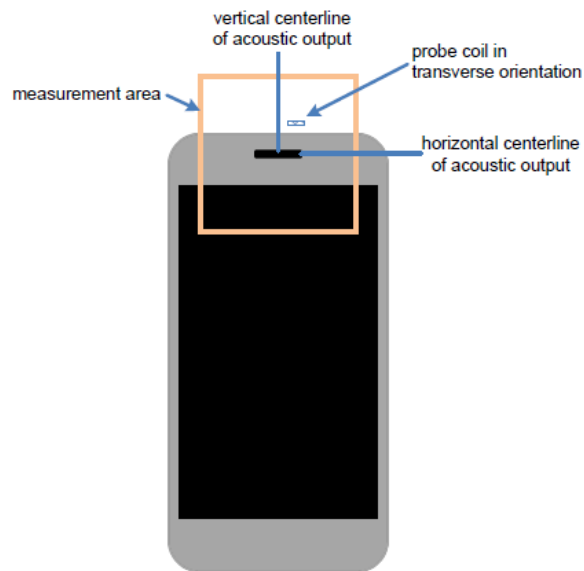


Figure A.4—Measurement and reference planes probe orientation for WD audio frequency magnetic field measurements

Figure 3 Axis and planes for WD audio frequency magnetic field measurements

### 5.3 T-Coil Measurement Procedure

According to ANSI C63.19-2019, section4:

This subclause describes the procedures used to measure the ABM (T-Coil) performance of the WD. Measurements shall be performed over a measurement area 50 mm square, in the measurement plane, as specified in A.3. The measurement area shall be scanned with a uniform measurement point spacing of 2.0 mm  $\pm$  0.5 mm in each X=Y axis of the plane, yielding 676 measurement points with approximately even spacing throughout the area.

Optionally, measurement point spacing may be increased to 4 mm, with interpolation employed to yield the required 676 equivalent measurement points distributed uniformly over the 50 mm square measurement area. Interpolated points shall be derived from the average of the linear representations of the field strengths of the nearest two or four equidistant measured points. The area of measurement is increased to a 52 mm square so that edge rows and columns of the required 50 mm square can be either measured or interpolated with none extrapolated.

In order to assure that the required signal quality is measured, the measurement of the intended signal and the measurement of the unintended signal shall be made at the same locations. Measurements shall not include undesired influence from the WD's RF field; therefore, use of a coaxial connection to a base station simulator or non-radiating load might be necessary. However, even then with a coaxial connection to a base station simulator or non-radiating load there could still be RF leakage from the WD, which could interfere with the desired measurement. Pre-measurement checks should be made to avoid this possibility. All measurements shall be done with the WD operating on battery power with an appropriate normal speech audio signal input level given in Table 6.1. If the device display can be turned off during a phone call, then that may be done during the measurement as well. If tested with the display in the off state this shall be documented in the test report.

Measurements shall be performed with the probe coil oriented in the transverse direction, aligned in the plane of the measurement area and perpendicular to the long dimension of the WD. A multi-stage sequence consists of first measuring the field strength of the desired T-Coil signal (desired ABM signal) that is useful to a hearing aid.

T-Coil at each specified measurement point. The undesired magnetic component (undesired ABM field) is then measured in the same transverse orientation at each of the same measurement point.

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

To minimize the need to test every WD operating mode to the telecoil requirements of Clause 6, it is permissible to exclude some subset of supported configurations. For a given WD, every mode that supports voice communication shall be considered for telecoil testing. However, if it can be demonstrated that a certain configuration will not be the worst-case telecoil configuration, such configurations may be excluded from the full telecoil scans of 6.4.}4 For example, operating modes may be pre-screened by scanning for both desired ABM signal and undesired ABM field at a lower measurement point density than the final scans, thus saving considerable testing time by eliminating configurations that are excellent performers from more detailed testing for worst-case.

Many factors could affect telecoil test results. RF power level and amplitude modulation characteristics as well as the specific current paths within the WD associated with the RF output stage(s), the display, and processing circuitry could affect the undesired ABM field. Audio codec implementation and acoustic receiver characteristics could also affect the desired ABM signal).

## 6 T-Coil testing for CMRS Voice

### 6.1 General Description

#### 1. Codec Investigation:

This clause describes the measurement of the baseband (audio frequency) magnetic T-Coil signal from a WD. The goal is to evaluate the size of the area where a user could position their WD relative to their hearing aid's telecoil and receive an acceptable magnetically coupled signal. Three quantities are measured and evaluated. The first is the field strength of the desired signal at the center of the audio band (desired ABM signal). The second is the frequency response of the desired signal measured across the audio band. The third is the field strength of the undesired audio band magnetic field.

#### 2. Air Interface Investigation:

- Use the worst-case codec test and document a limited set of bands/channel/bandwidths. Observe the effect of changing the band and bandwidth to ensure that there are no unexpected variations. Using the knowledge of the observed variations, it is necessary to report only a set band/channel/bandwidth for each orientation for a voice service/air interface.
- According to the ANSI C63.19 2019 section 6.3.4, test middle channel of each frequency band for HAC testing for each orientation to determine worst HAC T-Coil.
- Opening the Hearing-aid can improve the HAC T-Coil performance of the earpiece.

### 6.2 UMTS Tests Results

#### Air Interface Investigation:

| Air Interface | Modulation | Channel | Codec           | Primary Group Contiguous Point Count | Secondary Group Contiguous Point Count | Secondary Group Max Longitudinal | Secondary Group Max Transverse | Frequency Response | Date       |
|---------------|------------|---------|-----------------|--------------------------------------|----------------------------------------|----------------------------------|--------------------------------|--------------------|------------|
| WCDMA IV      | Voice      | 1412    | AMR WB 6.60Kbps | 199                                  | 676                                    | 26                               | 26                             | PASS               | 2025/12/10 |

#### Remark:

- Phone Condition: Air Link; Hearing-aid on; Mute on; Backlight off; Max Volume
- The detail frequency response results please refer to appendix A.

## 7 T-Coil testing for CMRS IP Voice

### 7.1 VoLTE and VoNR Tests Results

#### 1. Codec Investigation:

For a voice service/air interface, investigate the variations of codec configurations (NB bit rate) and document the parameters for that voice service. It is only necessary to document this for one channel / band, the following worst investigation codec would be remarked to be used for the testing for the handset.

#### 2. Air Interface Investigation:

a. Use the worst-case codec test and document a limited set of bands / channel / bandwidths. Observe the effect of changing the band and bandwidth to ensure that there are no unexpected variations. Using the knowledge of the observed variations, it is necessary to report only a set band/channel/bandwidth for each orientation for a voice service/air interface and the following worst configure would be remarked to be used for the testing for the handset.

b. Select one frequency band to do measurement at the worst Primary Group Contiguous Point Count position was additionally performed with varying the BWs/Modulations/RB size to verify the variation to find out worst configuration, the observed variation is very little to be within 1.5 dB which is much less than the margin from the rating threshold.

#### LTE FDD Air interface:

| Air Interface | BW | Modulation | RB | RB | Channel | Codec          | Primary Group Contiguous Point Count | Secondary Group Contiguous Point Count | Secondary Group Max Longitudinal | Secondary Group Max Transverse | Frequency Response | Date      |
|---------------|----|------------|----|----|---------|----------------|--------------------------------------|----------------------------------------|----------------------------------|--------------------------------|--------------------|-----------|
| LTE Band 7    | 20 | QPSK       | 1  | 0  | 21100   | EVS NB 5.9Kbps | 177                                  | 676                                    | 26                               | 26                             | PASS               | 2025/12/9 |
| LTE Band 14   | 10 | QPSK       | 1  | 0  | 23330   | EVS NB 5.9Kbps | 117                                  | 676                                    | 26                               | 26                             | PASS               | 2025/12/9 |

#### Remark:

1. Phone Condition: Air Link; Hearing-aid on; Mute on; Backlight off; Max Volume
2. The detail frequency response results please refer to appendix A

#### FR1 NR Air interface:

| Air Interface | BW | Modulation      | RB | RB | Channel | Codec          | Primary Group Contiguous Point Count | Secondary Group Contiguous Point Count | Secondary Group Max Longitudinal | Secondary Group Max Transverse | Frequency Response | Date       |
|---------------|----|-----------------|----|----|---------|----------------|--------------------------------------|----------------------------------------|----------------------------------|--------------------------------|--------------------|------------|
| FR1 n14       | 10 | DFT-s-OFDM QPSK | 1  | 1  | 158600  | EVS WB 5.9Kbps | 308                                  | 676                                    | 26                               | 26                             | PASS               | 2025/12/10 |

## 8 Equipment list

| Test Equipment                                                           | Manufacturer | Model No. | Inventory No. | Cal. Date  | Cal. Due date |
|--------------------------------------------------------------------------|--------------|-----------|---------------|------------|---------------|
| <input checked="" type="checkbox"/> Software                             | SPEAG        | DASY8     | NA            | NCR        | NCR           |
| <input checked="" type="checkbox"/> DAE                                  | SPEAG        | DAE4      | 1740          | 2025-02-17 | 2026-02-16    |
| <input checked="" type="checkbox"/> Audio Magnetic 1D Field Probe        | SPEAG        | AM1DV3    | 3128          | 2025-06-12 | 2026-06-11    |
| <input checked="" type="checkbox"/> Test Arch SD HAC                     | SPEAG        | NA        | NA            | NCR        | NCR           |
| <input checked="" type="checkbox"/> Audio Magnetic Measuring Instrument  | SPEAG        | AMMI      | 1028          | NCR        | NCR           |
| <input checked="" type="checkbox"/> Audio Magnetic                       | SPEAG        | AMCC      | 1143          | NCR        | NCR           |
| <input checked="" type="checkbox"/> Universal Radio Communication Tester | R&S          | CMW500    | 111637        | 2025-09-03 | 2026-09-02    |
| <input checked="" type="checkbox"/> RADIO COMMUNICATION TESTR            | R&S          | CMX500    | 101930        | 2025-01-16 | 2026-01-15    |
| <input checked="" type="checkbox"/> Humidity and Temperature Indicator   | MingGao      | MingGao   | NA            | 2025-09-16 | 2026-09-15    |

Note:

1. All the equipment are within the valid period when the tests are performed.
2. NCR: "No-Calibration Required".

## **9 Calibration certificate**

Please see the Appendix B

## **10 Photographs**

Please see the Appendix C

## **Appendix A: Detailed Test Results**

## **Appendix B: Calibration certificate**

## **Appendix C: Photographs**

--- End of report ---