



中国认可  
国际互认  
检测  
TESTING  
CNAS L0310



## FCC HAC (T-Coil) Compliance Test Report

Product Name: Smart Phone

Model: H1711,H1711z

Report No.: SYBH(Z-SAR)017042017-H2

FCC ID: QISH1711

|      | APPROVED<br>(Lab Manager) | PREPARED<br>(Test Engineer) |
|------|---------------------------|-----------------------------|
| BY   | <i>Wei Kuanbin</i>        | <i>He Peng</i>              |
| DATE | 2017-06-06                | 2017-06-06                  |

**Reliability Laboratory of Huawei Technologies Co., Ltd.**

**(Global Compliance and Testing Center of Huawei Technologies Co., Ltd)**

Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang  
District, Shenzhen, 518129, P.R.C  
Tel: +86 755 28780808 Fax: +86 755 89652518

**※ ※ Notice ※ ※**

1. The laboratory has passed the accreditation by China National Accreditation Service for Conformity Assessment (CNAS). The accreditation number is L0310.
2. The laboratory has passed the accreditation by The American Association for Laboratory Accreditation (A2LA). The accreditation number is 2174.01 & 2174.02 & 2174.03
3. The laboratory (Reliability Lab of Huawei Technologies Co., Ltd) is also named “Global Compliance and Testing Center of Huawei Technologies Co., Ltd”, the both names have coexisted since 2009.
4. The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.
5. The test report is invalid if there is any evidence of erasure and/or falsification.
6. The test report is only valid for the test samples.
7. Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

## Table of Contents

|       |                                                     |    |
|-------|-----------------------------------------------------|----|
| 1     | General Information .....                           | 5  |
| 1.1   | Statement of Compliance .....                       | 5  |
| 1.2   | EUT Description .....                               | 6  |
| 1.2.1 | General Description .....                           | 7  |
| 1.2.2 | List of air interfaces/frequency bands .....        | 8  |
| 1.3   | Test specification(s) .....                         | 9  |
| 1.4   | Testing laboratory .....                            | 9  |
| 1.5   | Applicant and Manufacturer .....                    | 9  |
| 1.6   | Application details .....                           | 9  |
| 1.7   | Ambient Condition .....                             | 9  |
| 2     | HAC(T-Coil) Measurement System .....                | 10 |
| 2.1   | T-Coil Measurement Set-up .....                     | 10 |
| 2.2   | Probe description .....                             | 11 |
| 2.3   | AMCC .....                                          | 12 |
| 2.4   | AMMI .....                                          | 12 |
| 2.5   | Test Arch Phantom & Phone Positioner .....          | 12 |
| 2.6   | Test Equipment List .....                           | 13 |
| 2.7   | Measurement Uncertainty Evaluation .....            | 14 |
| 3     | HAC(T-Coil) Measurement .....                       | 15 |
| 3.1   | T-Coil measurement points and reference plane ..... | 15 |
| 3.2   | T-Coil Measurement Procedure .....                  | 16 |
| 3.3   | T-Coil Performance Requirements .....               | 18 |
| 4     | HAC(T-Coil) Test Configuration .....                | 20 |
| 4.1   | General Description .....                           | 20 |
| 4.2   | GSM Test Configuration .....                        | 20 |
| 4.3   | UMTS Test Configuration .....                       | 20 |
| 5     | HAC(T-Coil) Measurement Results .....               | 21 |
|       | Appendix A. T-Coil Measurement Plots .....          | 24 |
|       | Appendix B. Calibration Certificate .....           | 24 |
|       | Appendix C. Photo documentation .....               | 24 |

※ ※ Modified History ※ ※

| REV.    | DESCRIPTION                    | ISSUED DATE | REMARK  |
|---------|--------------------------------|-------------|---------|
| Rev.1.0 | Initial Test Report Release    | 2017-05-19  | He Peng |
| Rev.1.1 | Update the battery information | 2017-06-06  | He Peng |
|         |                                |             |         |

## 1 General Information

### 1.1 Statement of Compliance

The T-rating of Hearing-Aid Compatibility (HAC) found during testing for H1711,H1711z are as below Table 1. So the T-rating of H1711,H1711z are **T3**.

| Band                | T-rating  |
|---------------------|-----------|
| <b>GSM 850</b>      | <b>T3</b> |
| <b>GSM 1900</b>     | <b>T3</b> |
| <b>UMTS Band II</b> | T4        |
| <b>UMTS Band IV</b> | T4        |
| <b>UMTS Band V</b>  | T4        |

Table 1: Summary of test results

Note:

- 1) This portable wireless equipment has been shown to be hearing-aid compatible under the above rated category, specified in ANSI/IEEE Std.C63.19-2011 and had been tested in accordance with the specified measurement procedures, Hear-Aid Compatibility is based on the assumption that all production units will be designed electrically identical to the device tested in this report. Test results reported herein relate only to the item(s) tested and are for North American Bands only.
- 2) No associated VOIP T-Coil measurement has been made in accordance with the guidance issued by OET in KDB Publication 285076 D02 T-Coil Testing for CMRS IP.

## 1.2 EUT Description

| Device Information:              |                                                                                            |                                     |           |
|----------------------------------|--------------------------------------------------------------------------------------------|-------------------------------------|-----------|
| DUT Name:                        | Smart Phone                                                                                |                                     |           |
| Type Identification:             | H1711,H1711z                                                                               |                                     |           |
| FCC ID :                         | QISH1711                                                                                   |                                     |           |
| SN:                              | 1#: 74H0117405000605<br>2#: JAT0117410000557                                               |                                     |           |
| Device Type :                    | Portable device                                                                            |                                     |           |
| Exposure Category:               | Uncontrolled environment / general population                                              |                                     |           |
| Device Phase:                    | Identical Prototype                                                                        |                                     |           |
| Hardware Version :               | HL3TRTM                                                                                    |                                     |           |
| Software Version :               | H1711C07B032                                                                               |                                     |           |
| Antenna Type :                   | Internal                                                                                   |                                     |           |
| Others Accessories               | Headset                                                                                    |                                     |           |
| Device Operating Configurations: |                                                                                            |                                     |           |
| Supporting Mode(s)               | GSM850/1900;UMTS Band II/IV/V(Tested);<br>LTE Band II/IV/V/XII/XXX,WiFi 2.4G/5G, Bluetooth |                                     |           |
| Test Modulation                  | GSM(GMSK/8-PSK), UMTS(QPSK), LTE(QPSK/16QAM),<br>WiFi(DSSS/OFDM)                           |                                     |           |
| Operating Frequency Range(s)     | Band(MHz)                                                                                  | Tx (MHz)                            | Rx (MHz)  |
|                                  | GSM850                                                                                     | 824-849                             | 869-894   |
|                                  | GSM1900                                                                                    | 1850-1910                           | 1930-1990 |
|                                  | UMTS Band II                                                                               | 1850-1910                           | 1930-1990 |
|                                  | UMTS Band IV                                                                               | 1710-1755                           | 2110-2170 |
|                                  | UMTS Band V                                                                                | 824-849                             | 869-894   |
|                                  | LTE Band II                                                                                | 1850-1910                           | 1930-1990 |
|                                  | LTE Band IV                                                                                | 1710-1755                           | 2110-2170 |
|                                  | LTE Band V                                                                                 | 824-849                             | 869-894   |
|                                  | LTE Band XII                                                                               | 699-716                             | 729-746   |
|                                  | LTE Band XXX                                                                               | 2305-2315                           | 2350-2360 |
|                                  | WiFi 2.4G                                                                                  | 2400-2472                           |           |
|                                  | WiFi 5G                                                                                    | 5170-5330<br>5490-5710<br>5735-5835 |           |
|                                  | BT                                                                                         | 2400-2472                           |           |
|                                  | GPS                                                                                        | /                                   | 1575.42   |
| HSDPA UE Category                | 14                                                                                         |                                     |           |
| HSUPA UE Category                | 6                                                                                          |                                     |           |
| DC-HSDPA UE Category             | 24                                                                                         |                                     |           |
| Power Class :                    | 4,tested with power level 5(GSM850)                                                        |                                     |           |
|                                  | 1,tested with power level 0(GSM1900)                                                       |                                     |           |
|                                  | 3, tested with power control “all 1”(UMTS Band II)                                         |                                     |           |
|                                  | 3, tested with power control “all 1”(UMTS Band V)                                          |                                     |           |
|                                  | 3, tested with power control “all 1”(UMTS Band IV)                                         |                                     |           |
| Test Channels (mid) :            | 190CH(GSM850)                                                                              |                                     |           |
|                                  | 661CH(GSM1900)                                                                             |                                     |           |
|                                  | 9400CH(UMTS Band II)                                                                       |                                     |           |
|                                  | 1413CH(UMTS Band IV)                                                                       |                                     |           |
|                                  | 4182CH(UMTS Band V)                                                                        |                                     |           |

Table 2: Device information and operating configuration

### 1.2.1 General Description

H1711 is subscriber equipment in the GSM/UMTS/LTE system. The GSM frequency band includes GSM850 and GSM900 and DCS1800 and PCS1900. The UMTS frequency band is band 1/2/4/5. The LTE frequency band is band 2/4/5/12/30. The Mobile Phone implements such functions as RF signal receiving/transmitting, LTE/UMTS and GSM/GPRS/EDGE protocol processing, voice, video MMS service, GPS and WIFI etc. Externally it provides micro SD card interface, earphone port (to provide voice service) . It also provides bluetooth module to synchronize data between a PC and the phone, or to use the built-in modem of the phone to access the Internet with a PC, or to exchange data with other bluetooth devices.

H1711z is subscriber equipment in the GSM/UMTS/LTE system. The GSM frequency band includes GSM850 and GSM900 and DCS1800 and PCS1900. The UMTS frequency band is band 1/2/4/5. The LTE frequency band is band 2/4/5/12/30. The Mobile Phone implements such functions as RF signal receiving/transmitting, LTE/UMTS and GSM/GPRS/EDGE protocol processing, voice, video MMS service, GPS and WIFI etc. Externally it provides micro SD card interface, earphone port (to provide voice service) . It also provides bluetooth module to synchronize data between a PC and the phone, or to use the built-in modem of the phone to access the Internet with a PC, or to exchange data with other bluetooth devices.

#### Battery Information:

| Name                   | Manufacture | Serials number | Description                                                                                                     |
|------------------------|-------------|----------------|-----------------------------------------------------------------------------------------------------------------|
| Rechargeable<br>Li-ion | Desay       | NA             | Battery Model: HB406689ECW<br>Minimal capacity: 3900mAh<br>Typical Capacity: 4000mAh<br>Nominal Voltage: 3.82 V |
|                        | Scud        |                |                                                                                                                 |

The difference with H1711 and H1711z are as below:

| Model                |                           | H1711    | H1711z     |
|----------------------|---------------------------|----------|------------|
| Licensed frequency   | LTE/UMTS/GSM              | The same | The same   |
| Unlicensed frequency | BT/WIFI                   | The same | The same   |
| hardware             | RAM/PCB                   | The same | The same   |
| Appearance           | dimension                 | The same | The same   |
|                      | camera                    | The same | The same   |
| accessory            | Adaptor/USB cable/battery | The same | The same   |
| antenna              |                           | The same | The same   |
| BT/WIFI              |                           | The same | The same   |
| VOWIFI               |                           | support  | No support |
| VOLTE                |                           | support  | No support |
| others               |                           | The same | The same   |

Note: Based on the difference description above, full test is performed on H1711. H1711z shares the same test data of H1711 for the same frequency bands .

### 1.2.2 List of air interfaces/frequency bands

| Air-Interface                                                                                                            | Bands (MHz)   | Type | C63.19 HAC tested | Simultaneous but not tested | OTT | Concurrent HAC Tested | Additional GSM power reduction |
|--------------------------------------------------------------------------------------------------------------------------|---------------|------|-------------------|-----------------------------|-----|-----------------------|--------------------------------|
| GSM                                                                                                                      | 850           | VO   | Yes               | Yes:WiFi/BT                 | N/A | Not tested*           | N/A                            |
|                                                                                                                          | 1900          | VO   | Yes               | Yes:WiFi/BT                 | N/A | Not tested*           | N/A                            |
|                                                                                                                          | GPRS/EDGE     | DT   | No                | Yes:WiFi/BT                 | Yes | N/A                   | N/A                            |
| UMTS                                                                                                                     | Band II(1900) | VO   | Yes               | Yes:WiFi/BT                 | N/A | Not tested*           | N/A                            |
|                                                                                                                          | Band IV(1700) | VO   | Yes               | Yes:WiFi/BT                 | N/A | Not tested*           | N/A                            |
|                                                                                                                          | Band V(850)   | VO   | Yes               | Yes:WiFi/BT                 | N/A | Not tested*           | N/A                            |
|                                                                                                                          | HSPA/DC-HSDPA | DT   | No                | Yes:WiFi/BT                 | Yes | N/A                   | N/A                            |
| LTE                                                                                                                      | LTE Band II   | VD   | No                | Yes:With/BT                 | Yes | Not tested*           | N/A                            |
|                                                                                                                          | LTE Band IV   | VD   | No                | Yes:With/BT                 | Yes | Not tested*           | N/A                            |
|                                                                                                                          | LTE Band V    | VD   | No                | Yes:With/BT                 | Yes | Not tested*           | N/A                            |
|                                                                                                                          | LTE Band XII  | VD   | No                | Yes:With/BT                 | Yes | Not tested*           | N/A                            |
|                                                                                                                          | LTE Band XXX  | VD   | No                | Yes:With/BT                 | Yes | Not tested*           | N/A                            |
| WiFi                                                                                                                     | 2450          | VD   | No                | Yes:GSM/UMTS/<br>/LTE       | Yes | Not tested*           | N/A                            |
| WiFi                                                                                                                     | 5G            | VD   | No                | Yes:GSM/UMTS/<br>/LTE       | Yes | Not tested*           | N/A                            |
| BT                                                                                                                       | 2450          | DT   | No                | Yes:GSM/UMTS/<br>/LTE       | N/A | N/A                   | N/A                            |
| Type Transport:<br>VO = CMRS Voice Service<br>DT = Digital Transport<br>VD = CMRS IP Voice Service and Digital Transport |               |      |                   |                             |     |                       |                                |

- 1) \*- No concurrent mode was found to be the worst case mode.
- 2) The device H1711 supports VoLTE and VoWiFi.
- 3) No associated VOIP T-Coil measurement has been made in accordance with the guidance issued by OET in KDB Publication 285076 D02 T-Coil Testing for CMRS IP.

### 1.3 Test specification(s)

|                  |                                                                                                               |
|------------------|---------------------------------------------------------------------------------------------------------------|
| ANSI C63.19-2011 | American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices |
| KDB 285076 D01   | HAC Guidance v04r01                                                                                           |
| KDB 285076 D02   | T-Coil testing for CMRS IP v02                                                                                |

### 1.4 Testing laboratory

|                        |                                                                                                                                                                      |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Site              | Reliability Laboratory of Huawei Technologies Co., Ltd.                                                                                                              |
| Test Location          | Section G1, Huawei Base Bantian, Longgang District, Shenzhen 518129, P.R. China                                                                                      |
| Telephone              | +86 755 28780808                                                                                                                                                     |
| Fax                    | +86 755 89652518                                                                                                                                                     |
| State of accreditation | The Test laboratory (area of testing) is accredited according to ISO/IEC 17025.<br>CNAS Registration number: L0310<br>A2LA TESTING CERT #2174.01 & 2174.02 & 2174.03 |

### 1.5 Applicant and Manufacturer

|              |                                                                                                                             |
|--------------|-----------------------------------------------------------------------------------------------------------------------------|
| Company Name | HUAWEI TECHNOLOGIES CO., LTD                                                                                                |
| Address      | Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C |

### 1.6 Application details

|                    |            |
|--------------------|------------|
| Start Date of test | 2017-05-14 |
| End Date of test   | 2017-05-16 |

### 1.7 Ambient Condition

|                     |             |
|---------------------|-------------|
| Ambient temperature | 20°C – 24°C |
| Relative Humidity   | 30% – 70%   |

## 2 HAC(T-Coil) Measurement System

### 2.1 T-Coil Measurement Set-up

These measurements are performed using the DASY5 NEO automated dosimetric assessment system. It is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland. It consists of high precision robotics system (Stäubli), robot controller, Lenovo Intel Core i5 3.1 GHz computer, near-field probe, probe alignment sensor. The robot is a six-axis industrial robot performing precise movements. A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The PC consists of Lenovo Intel Core i5 3.1 GHz computer with Windows 7 system and HAC Measurement Software DASY5 NEO, A/D interface card, monitor, mouse, and keyboard. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

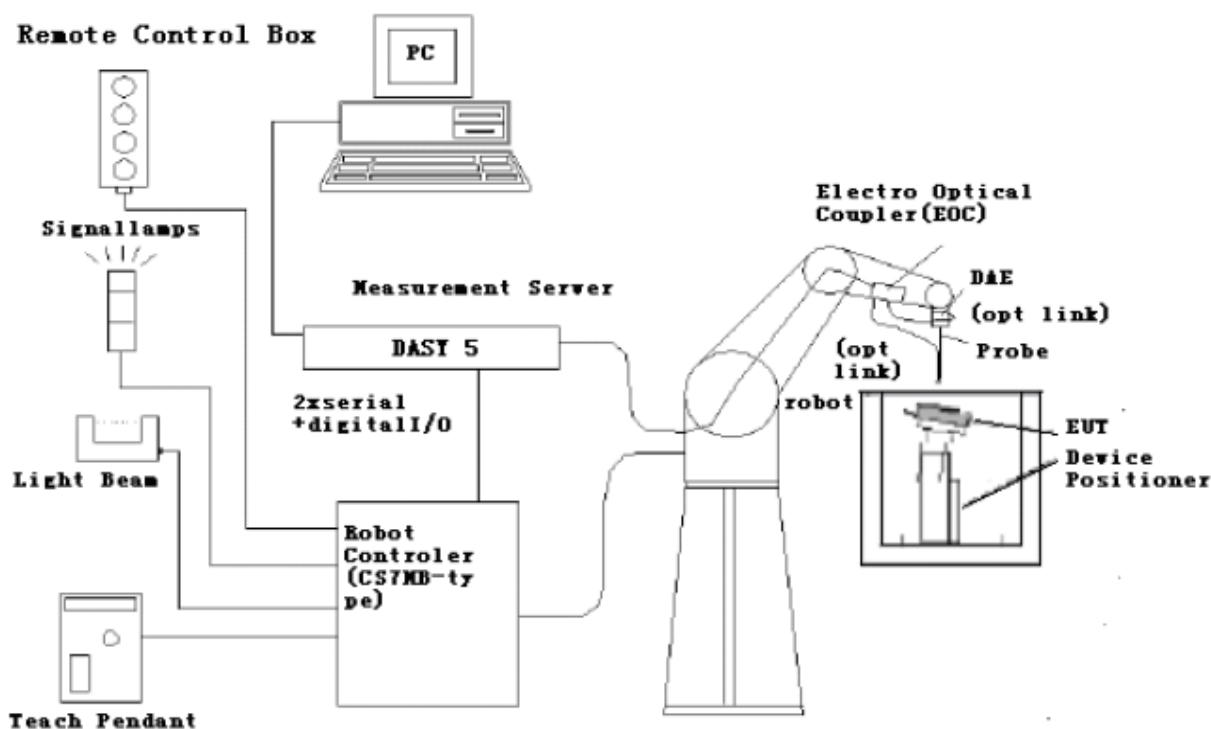


Fig. 1 HAC Test Measurement Set-up

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

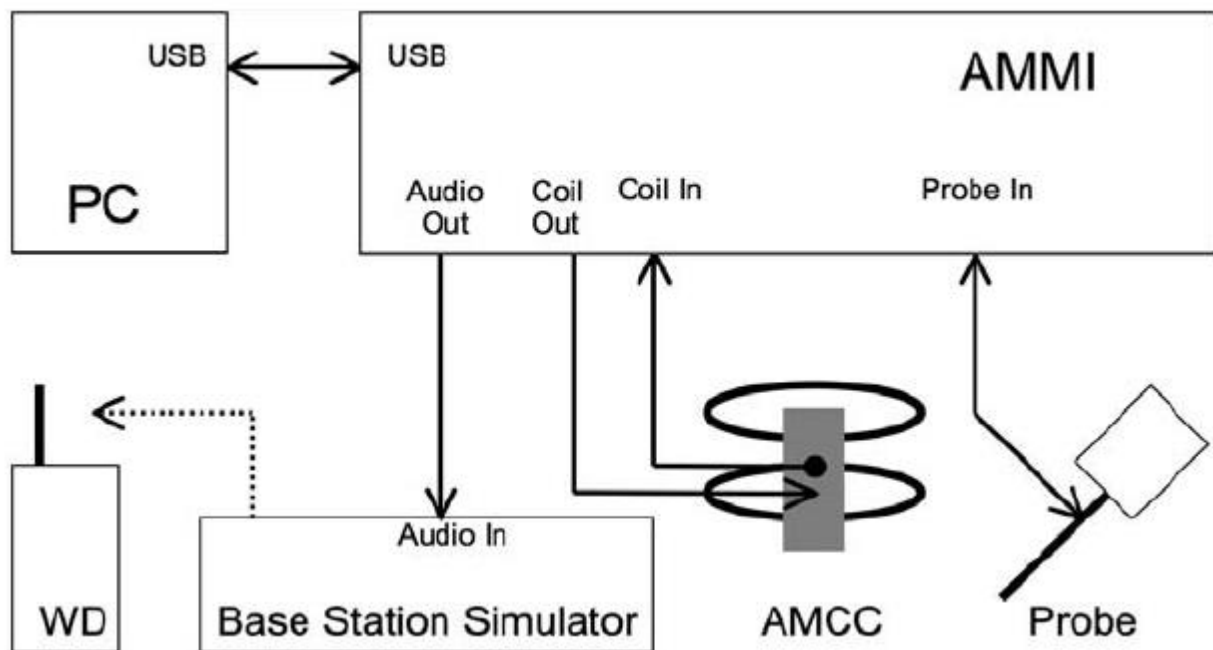


Fig. 2 T-Coil setup with HAC Test Arch and AMCC

## 2.2 Probe description

### AM1D probe Description

The AM1D probe is an active probe with a single sensor. It is fully RF-shielded and has a rounded tip 6mm in diameter incorporating a pickup coil with its center offset 3mm from the tip and the sides. The symmetric signal preamplifier in the probe is fed via the shielded symmetric output cable from the AMMI with a 48V "phantom" voltage supply. The 7-pin connector on the back in the axis of the probe does not carry any signals. It is mounted to the DAE for the correct orientation of the sensor. If the probe axis is tilted 54.7 degree from the vertical, the sensor is approximately vertical when the signal connector is at the underside of the probe (cable hanging downwards).

|                        |                                                               |                                                                                       |
|------------------------|---------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <b>Frequency range</b> | 0.1~20kHz (RF sensitivity < -100dB, fully RF shielded)        |  |
| <b>Sensitivity</b>     | < -50dB A/m @ 1kHz                                            |                                                                                       |
| <b>Pre-amplifier</b>   | 40dB, symmetric                                               |                                                                                       |
| <b>Dimensions</b>      | Tip diameter/length: 6/290mm, sensor according to ANSI-C63.19 |                                                                                       |

## 2.3 AMCC

The Audio Magnetic Calibration coil is a Helmholtz Coil designed for calibration of the AM1D probe. The two horizontal coils generate a homogeneous magnetic field in the z direction. The DC input resistance is adjusted by a series resistor to approximately 50Ohm, and a shunt resistor of 10Ohm permits monitoring the current with a scale of 1:10.

Port description:

| Signal       | Connector | Resistance                                    |
|--------------|-----------|-----------------------------------------------|
| Coil In      | BNC       | Typically 50Ohm                               |
| Coil Monitor | BNO       | 10Ohm $\pm$ 1% (100mV corresponding to 1 A/m) |

Specification:

|            |                                              |
|------------|----------------------------------------------|
| Dimensions | 370 x 370 x 196 mm, according to ANSI-C63.19 |
|------------|----------------------------------------------|

## 2.4 AMMI



**Figure 3 AMMI front panel**

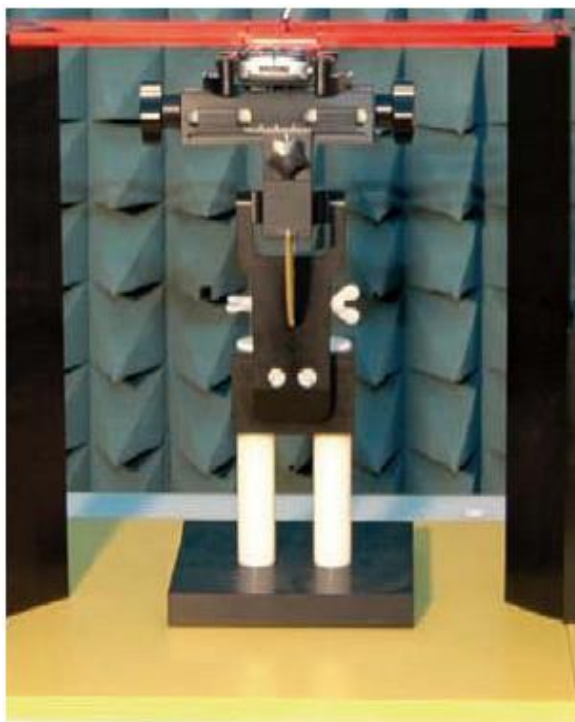
The Audio Magnetic Measuring Instrument (AMMI) is a desktop 19-inch unit containing a sampling unit, a waveform generator for test and calibration signals, and a USB interface.

|                        |                                                                           |
|------------------------|---------------------------------------------------------------------------|
| Sampling rate          | 48 kHz / 24 bit                                                           |
| Dynamic range          | 85 dB                                                                     |
| Test signal generation | User selectable and predefined (vis PC)                                   |
| Calibration            | Auto-calibration / full system calibration using AMCC with monitor output |
| Dimensions             | 482 x 65 x 270 mm                                                         |

## 2.5 Test Arch Phantom & Phone Positioner

The Test Arch phantom should be positioned horizontally on a stable surface. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. It enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot (Dimensions: 370 x 370 x 370 mm).

The Phone Positioner supports accurate and reliable positioning of any phone with effect on near field <  $\pm 0.5$  dB.



**Fig. 4 HAC Phantom & Device Holder**

## 2.6 Test Equipment List

This table gives a complete overview of the HAC measurement equipment. Devices used during the test described are marked ☒

| No. | Manufacturer | Device                               | Type          | Serial number | Date of last calibration | Valid period |
|-----|--------------|--------------------------------------|---------------|---------------|--------------------------|--------------|
| ☒   | SPEAG        | Audio Magnetic Field Probe           | AM1DV3        | 3126          | 2016-07-22               | One year     |
| ☒   | SPEAG        | Audio Magnetic Calibration Coil      | AMCC          | 1053          | NCR                      | NCR          |
| ☒   | SPEAG        | Audio Magnetic Measuring Instrument  | AMMI          | 1028          | NCR                      | NCR          |
| ☒   | SPEAG        | HAC Test Arch                        | SD HAC P01 BA | 1053          | NCR                      | NCR          |
| ☒   | SPEAG        | Data acquisition electronics         | DAE4          | 851           | 2016-07-22               | One year     |
| ☒   | SPEAG        | Software                             | DASY5         | N/A           | NCR                      | NCR          |
| ☒   | R & S        | Universal Radio Communication Tester | CMW500        | 158850        | 2016-06-09               | One year     |

## 2.7 Measurement Uncertainty Evaluation

| Error Description                     | Uncertainty Value | Probability Dist. | Divisor | ci ABM1 | ci ABM2 | Standard Uncertainty ABM1 | Standard Uncertainty ABM2 |
|---------------------------------------|-------------------|-------------------|---------|---------|---------|---------------------------|---------------------------|
| <b>Probe Sensitivity</b>              |                   |                   |         |         |         |                           |                           |
| Reference Level                       | ±3.0%             | N                 | 1       | 1       | 1       | ±3.0%                     | ±3.0%                     |
| AMCC Geometry                         | ±0.4%             | R                 | √3      | 1       | 1       | ±0.2%                     | ±0.2%                     |
| AMCC Current                          | ±1.0%             | R                 | √3      | 1       | 1       | ±0.6%                     | ±0.6%                     |
| Probe Positioning during Calibration. | ± 0.1%            | R                 | √3      | 1       | 1       | ±0.1%                     | ±0.1%                     |
| Noise Contribution                    | ± 0.7%            | R                 | √3      | 0.01    | 1       | ±0.0%                     | ±0.4%                     |
| Frequency Slope                       | ± 5.9%            | R                 | √3      | 0.1     | 1       | ±0.3%                     | ±3.5%                     |
| <b>Probe System</b>                   |                   |                   |         |         |         |                           |                           |
| Repeatability / Drift                 | ± 1.0%            | R                 | √3      | 1       | 1       | ±0.6%                     | ±0.6%                     |
| Linearity/Dynamic Range               | ± 0.6%            | R                 | √3      | 1       | 1       | ±0.4%                     | ±0.4%                     |
| Acoustic Noise                        | ± 1.0%            | R                 | √3      | 0.1     | 1       | ±0.1%                     | ±0.6%                     |
| Probe Angle                           | ± 2.3%            | R                 | √3      | 1       | 1       | ±1.4%                     | ±1.4%                     |
| Spectral Processing                   | ± 0.9%            | R                 | √3      | 1       | 1       | ±0.5%                     | ±0.5%                     |
| Integration Time                      | ± 0.6%            | N                 | 1       | 1       | 5       | ±0.6%                     | ±3.0%                     |
| Field Disturbance                     | ± 0.2%            | R                 | √3      | 0       | 1       | ±0.1%                     | ±0.1%                     |
| <b>Test Signal</b>                    |                   |                   |         |         |         |                           |                           |
| Ref. Signal Spectral Response         | ± 0.6%            | R                 | √3      | 1       | 1       | ±0.1%                     | ± 0.4%                    |
| <b>Positioning</b>                    |                   |                   |         |         |         |                           |                           |
| Probe Positioning                     | ± 1.9%            | R                 | √3      | 1       | 1       | ±1.1%                     | ±1.1%                     |
| Phantom Thickness                     | ± 0.9%            | R                 | √3      | 1       | 1       | ±0.5%                     | ±0.5%                     |
| DUT Positioning                       | ± 1.9%            | R                 | √3      | 1       | 1       | ±1.1%                     | ±1.1%                     |
| <b>External Contributions</b>         |                   |                   |         |         |         |                           |                           |
| RF Interference                       | ± 0.0%            | R                 | √3      | 1       | 0.3     | ±0.0%                     | ±0.0%                     |
| Test Signal Variation                 | ± 2.0%            | R                 | √3      | 1       | 1       | ±1.2%                     | ±1.2%                     |
| <b>Combined Uncertainty</b>           |                   |                   |         |         |         |                           |                           |
| Combined Std. Uncertainty (ABM Field) |                   |                   |         |         |         | <b>±4.1%</b>              | <b>±6.1%</b>              |
| Expanded Std. Uncertainty             |                   |                   |         |         |         | <b>±8.1%</b>              | <b>±12.3%</b>             |

Table 3: Measurement uncertainties for T-Coil

### 3 HAC(T-Coil) Measurement

#### 3.1 T-Coil measurement points and reference plane

Figure 5 illustrates the standard probe orientations. Position 1 is the perpendicular orientation of the probe coil; orientation 2 is the transverse orientation. The space between the measurement positions is not fixed. It is recommended that a scan of the WD be performed for each probe coil orientation and that the maximum level recorded be used as the reading for that orientation of the probe coil.

1) The reference plane is the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It is parallel to the centerline of the receiver area of the phone and is defined by the points of the receiver-end of the WD handset, which, in normal handset use, rest against the ear.

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

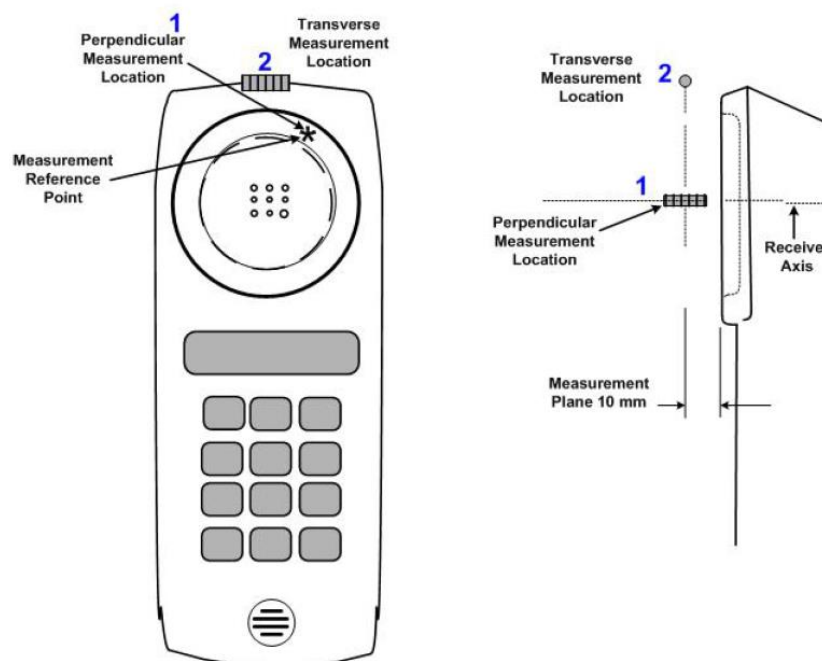
3) The reference axis is normal to the reference plane and passes through the center of the receiver speaker section (or the center of the hole array); or may be centered on a secondary inductive source. The actual location of the measurement point shall be noted in the test report as the measurement reference point.

4) The measurement points may be located where the perpendicular and transverse field intensity measurements are optimum with regard to the requirements. However, the measurement points should be near the acoustic output of the WD and shall be located 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.

5) The relative spacing of each measurement orientation is not fixed. The axial and two radial orientations should be chosen to select the optimal position.

6) The measurement point for the axial position is located 10 mm from the reference plane on the measurement axis.

7) The actual location of the measurement point shall be noted in test reports and designated as the measurement reference point.



**Figure 5 Axis and planes for WD audio frequency magnetic field measurements**

### 3.2 T-Coil Measurement Procedure

According 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 nonradiating load might be necessary. However, even with a coaxial connection to a base station simulator or nonradiating load, there might still be RF leakage from the WD, which can interfere with the desired measurement. Premeasurement 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.

Measurements 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 (ABM1) that is useful to a hearing aid T-Coil. The undesired magnetic components (ABM2) shall be examined for each probe orientation to determine the possible effects from the WD display and battery current paths that might disrupt the desired T-Coil signal. The undesired magnetic signal (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 nonradiating load as shown in ANSI C63.19-2011 Figure 7.1 or Figure 7.2. Confirm that the equipment that requires calibration has been calibrated and that the noise level meets the requirements of ANSI C63.19-2011 clause 7.3.1.
- c) The drive level to the WD is set such that the reference input level specified in ANSI C63.19-2011 Table 7.1 is input to the base station simulator (or manufacturer's test mode equivalent) in the 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 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.<sup>47</sup> 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 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  $f_i$ ) as specified in C63.19-2011 clause 7.4.4.2 in each ISO 266-1975 R10 standard 1/3 octave band. The desired audio band input frequency ( $f_i$ ) shall be centered in each 1/3 octave band maintaining the same drive level as determined in item c) and the reading taken for that band.

Equivalent methods of determining the frequency response may also be employed, such as fast Fourier transform (FFT) analysis using noise excitation or input–output comparison using simulated speech. The full-band integrated or half-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.)

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 C63.19-2011 clause 7.3.1.

f) At the measurement location for each orientation, measure and record the undesired broadband audio magnetic signal (ABM2) as specified in C63.19-2011 clause 7.4.4.4 with no audio signal applied (or digital zero applied, if appropriate) using A-weighting<sup>49</sup> and the half-band integrator. Calculate the ratio of the desired to undesired signal strength (i.e., signal quality).

g) Determine the category that properly classifies the signal quality, based on C63.19-2011 Table 8.5.

### 3.3 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.

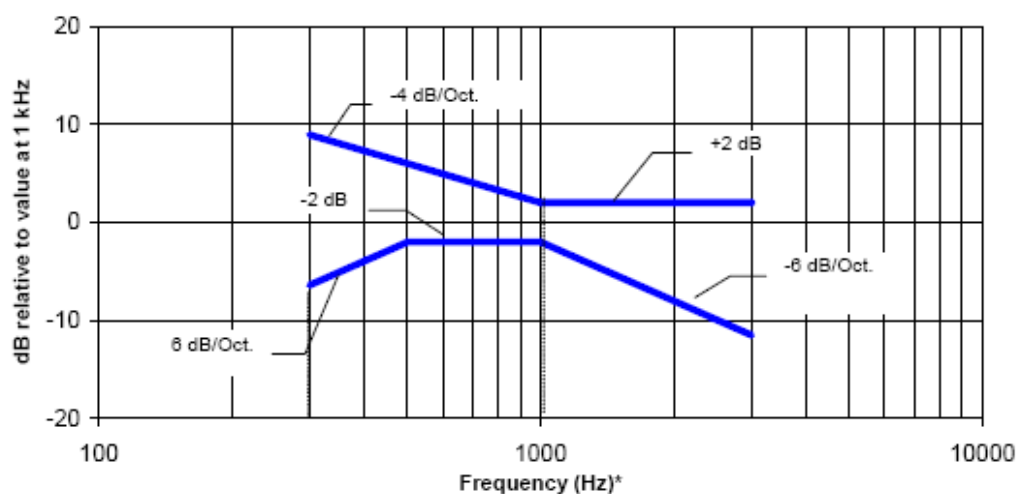
#### 1) T-Coil coupling field intensity

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

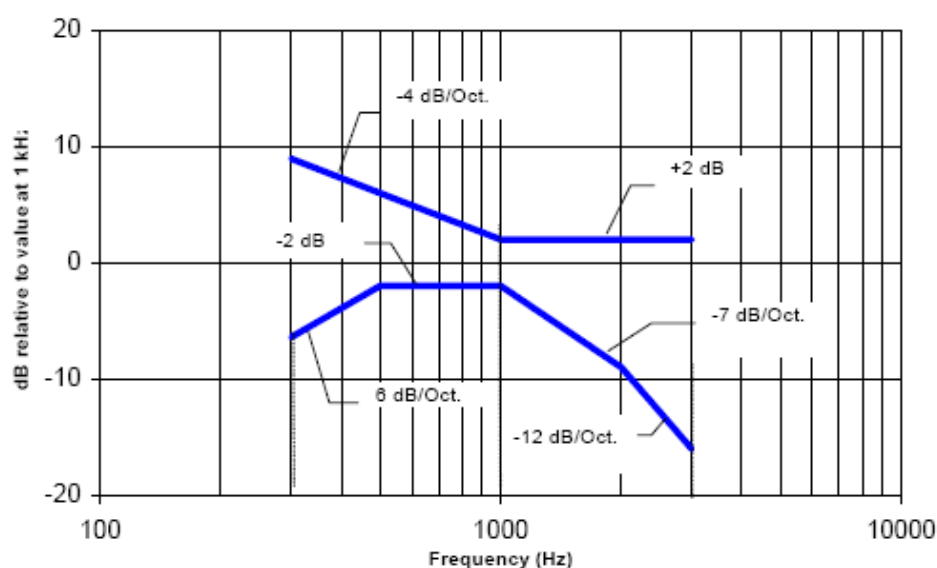
The frequency response of the axial component of the magnetic field, measured in 1/3 octave bands, shall follow the response curve specified in this sub-clause, over the frequency range 300 Hz to 3000 Hz. Figure 6 and Figure 7 provide the boundaries for the specified frequency.

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



NOTE—Frequency response is between 300 Hz and 3000 Hz.

**Figure 6—Magnetic field frequency response for WDs with a field  $\leq -15$  dB (A/m) at 1 kHz**



NOTE—Frequency response is between 300 Hz and 3000 Hz.

**Figure 7 —Magnetic field frequency response for WDs with a field that exceeds  $-15$  dB (A/m) at 1 kHz**

### 3) Signal quality

This part 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. So, the only criteria that can be measured is the RF immunity in T-Coil mode. This is measured using the same procedure as for the audio coupling mode and at the same levels.

The worst signal quality of the three T-Coil signal measurements shall be used to determine the T-Coil mode category per Table 4

| Category    | Telephone parameters WD signal quality<br>[(signal + noise) – to – noise ratio in decibels] |
|-------------|---------------------------------------------------------------------------------------------|
| Category T1 | 0 dB to 10 dB                                                                               |
| Category T2 | 10 dB to 20 dB                                                                              |
| Category T3 | 20 dB to 30 dB                                                                              |
| Category T4 | > 30 dB                                                                                     |

Table 4: T-Coil signal quality categories

## 4 HAC(T-Coil) Test Configuration

### 4.1 General Description

The phone was tested in all normal configurations for the ear use. The EUT is mounted in the device holder equivalent as for classic dosimeter measurements. The acoustic output of the EUT shall coincide with the center point of the area formed by the dielectric wire and the middle bar of the arch's top frame. The EUT shall be moved vertically upwards until it touches the frame. The fine adjustment is possible by sliding the complete. The EUT holder is on the yellow base plate of the Test Arch phantom. These test configurations are tested at the middle frequency channels of each applicable operating mode; for example, GSM, WCDMA(UMTS),CDMA and TDMA.

No correction gain factors were measured for UMTS/GSM due to the Rohde & Schwarz CMW500, hosting a calibrated audio board. The gains used to measure UMTS/GSM are set to 100.

### 4.2 GSM Test Configuration

A communication link is set up with a System Simulator (SS) by RF cable, and a call is established. The Absolute Radio Frequency Channel Number (ARFCN) are allocated to 190CH respectively in the case of GSM850, allocated to 661CH respectively in the case of GSM1900. T-Coil configurations is measured in Speechcod/Handset Low using System Simulator (SS), at the same time the EUT shall be operated at its maximum RF output power setting.

### 4.3 UMTS Test Configuration

A communication link is set up with a System Simulator (SS) by RF cable, and a call is established. The Absolute Radio Frequency Channel Number (ARFCN) are allocated to 9400CH respectively in the case of UMTS Band II, allocated to 1413 respectively in the case of UMTS Band IV, allocated to 4182 respectively in the case of UMTS Band V. T-Coil configurations is measured in voice mode (Voice Coder: Speechcodec Low) using System Simulator (SS), at the same time the EUT shall be operated at its maximum RF output power setting.

## 5 HAC(T-Coil) Measurement Results

| Band            | Mode  | Channel/<br>Freq.(MHz) | Probe<br>Orientation      | Position<br>(x <sub>mm</sub> ,y <sub>mm</sub> ) | ABM2<br>(dB<br>A/m) | ABM1<br>(dB<br>A/m) | SNR<br>(dB) | T-<br>Rating | Frequency<br>Response |
|-----------------|-------|------------------------|---------------------------|-------------------------------------------------|---------------------|---------------------|-------------|--------------|-----------------------|
| GSM<br>850      | Voice | 190/836.6              | Y<br>(Transversal)        | (0,0)                                           | -40.11              | 1.47                | 41.58       | T4           | /                     |
|                 |       |                        | Z<br>(Axial)              | (0,4.2)                                         | -22.48              | 9.77                | 32.25       | T4           | PASS                  |
|                 |       |                        | Test data with battery 2# |                                                 |                     |                     |             |              |                       |
|                 |       |                        | Y<br>(Transversal)        | (4.2, 4.2)                                      | -35.36              | -1.10               | 34.26       | T4           | /                     |
|                 |       |                        | Z<br>(Axial)              | (-4.2, 0)                                       | -27.21              | -1.69               | 25.52       | T3           | PASS                  |
| GSM<br>1900     | Voice | 661/1880               | Y<br>(Transversal)        | (0, 0)                                          | -39.70              | 1.59                | 41.29       | T4           | /                     |
|                 |       |                        | Z<br>(Axial)              | (0, 8.3)                                        | -25.31              | 9.04                | 34.35       | T4           | PASS                  |
|                 |       |                        | Test data with battery 2# |                                                 |                     |                     |             |              |                       |
|                 |       |                        | Y<br>(Transversal)        | (8.3, 0)                                        | -37.00              | -2.01               | 34.99       | T4           | /                     |
|                 |       |                        | Z<br>(Axial)              | (-4.2, 0)                                       | -29.86              | -2.29               | 27.57       | T3           | PASS                  |
| UMTS<br>Band II | Voice | 9400/1880              | Y<br>(Transversal)        | (4.2, 0,)                                       | -41.69              | 3.99                | 45.68       | T4           | /                     |
|                 |       |                        | Z<br>(Axial)              | (-4.2, 4.2)                                     | -41.42              | 5.47                | 46.89       | T4           | PASS                  |
|                 |       |                        | Test data with battery 2# |                                                 |                     |                     |             |              |                       |
|                 |       |                        | Y<br>(Transversal)        | (4.2, 4.2)                                      | -41.66              | -0.25               | 41.41       | T4           | /                     |
|                 |       |                        | Z<br>(Axial)              | (-4.2, 0,)                                      | -42.13              | -0.84               | 41.29       | T4           | PASS                  |
| UMTS<br>Band IV | Voice | 1413/1732.6            | Y<br>(Transversal)        | (4.2, 0)                                        | -41.41              | 4.00                | 45.41       | T4           | /                     |
|                 |       |                        | Z<br>(Axial)              | (-4.2, 4.2)                                     | -41.43              | 5.40                | 46.83       | T4           | PASS                  |
|                 |       |                        | Test data with battery 2# |                                                 |                     |                     |             |              |                       |
|                 |       |                        | Y<br>(Transversal)        | (4.2, 4.2,)                                     | -40.84              | -0.26               | 40.58       | T4           | /                     |
|                 |       |                        | Z<br>(Axial)              | (-4.2, 0)                                       | -41.97              | -0.93               | 41.04       | T4           | PASS                  |
| UMTS<br>Band V  | Voice | 4182/836.4             | Y<br>(Transversal)        | (4.2,0)                                         | -41.50              | 3.90                | 45.40       | T4           | /                     |
|                 |       |                        | Z<br>(Axial)              | (-4.2, -4.2)                                    | -41.15              | 5.38                | 46.53       | T4           | PASS                  |
|                 |       |                        | Test data with battery 2# |                                                 |                     |                     |             |              |                       |
|                 |       |                        | Y<br>(Transversal)        | (0, 4.2)                                        | -41.90              | -2.12               | 39.78       | T4           | /                     |
|                 |       |                        | Z<br>(Axial)              | (-4.2, -4.2)                                    | -42.72              | -3.07               | 39.65       | T4           | PASS                  |

Table 5: Test Result of T-Coil

Note:

- 1) The Hearing Aid mode of the software on this DUT is turned on during the test.
- 2) The volume is adjusted to the maximum level and the backlight turned off during the test.

The Frequency response plots of T-Coil are as below:



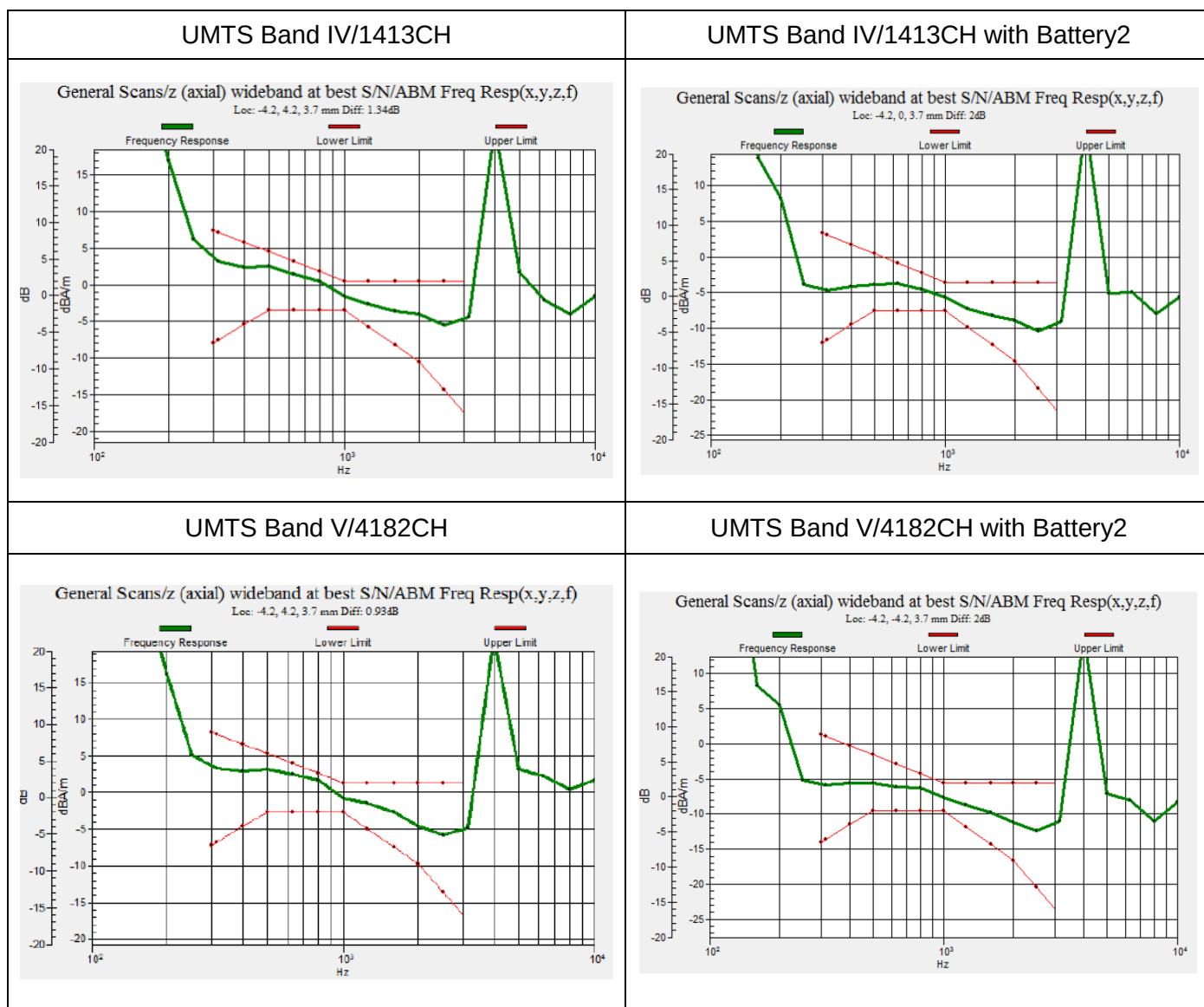


Table 6: Frequency response plots of T-Coil

## **Appendix A. T-Coil Measurement Plots**

(Pls See Appendix No.: SYBH(Z-SAR) 017042017-H2A, total: 66 pages)

## **Appendix B. Calibration Certificate**

(Pls See Appendix No.: SYBH(Z-SAR) 017042017-H2B, total:10 pages)

## **Appendix C. Photo documentation**

(Pls See Appendix No.: SYBH(Z-SAR) 017042017-H2C, total: 2 pages)

---

**END**