



# HAC RF Test Report

For

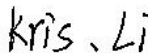
**Applicant Name:** UNNECTO HOLDING LIMITED  
**Address:** 13/F HARBOUR COMMERCIAL BUILDING 122-124  
CONNAUGHT ROAD CENTRAL SHEUNG WAN HK  
**EUT Name:** Mobile Phone  
**Brand Name:** unnecto™  
**Model Name:** Bolt 5G

## Issued By

**Company Name:** BTF Testing Lab (Shenzhen) Co., Ltd.  
**Address:** 101/201/301, Building 1, Block 2, Tantou Industrial Park,  
Tantou Community, Songgang Subdistrict, Bao'an District,  
Shenzhen, China

**Report Number:** BTF250801R00401  
**Test Standards:** ANSI C63.19-2019 FCC 47 CFR §20.19 KDB 285076 D01  
KDB 285076 D02 KDB 285076 D03  
**FCC ID:** 2ADR3UB501

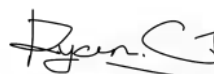
**Test Conclusion:** Pass  
**Test Date:** 2025-09-18  
**Date of Issue:** 2025-10-09

**Tested By:**   
Kris Li / Tester

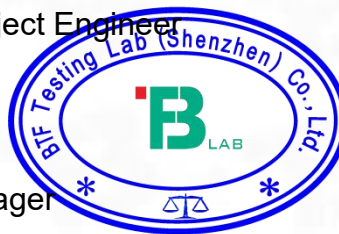
**Date:** 2025-10-09

**Reviewed By:** 

Amenda Zhong / Project Engineer  
**Date:** 2025-10-09

**Approved By:** 

Ryan.CJ / EMC Manager  
**Date:** 2025-10-09



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| Revision History |                                                                              |                   |
|------------------|------------------------------------------------------------------------------|-------------------|
| Version          | Issue Date                                                                   | Revisions Content |
| R_V0             | 2025-10-09                                                                   | Original          |
|                  |                                                                              |                   |
| Note:            | Once the revision has been made, then previous versions reports are invalid. |                   |

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## 1. Introduction

### 1.1 Identification of Testing Laboratory

|               |                                                                                                                                    |
|---------------|------------------------------------------------------------------------------------------------------------------------------------|
| Company Name: | BTF Testing Lab (Shenzhen) Co., Ltd.                                                                                               |
| Address:      | 101/201/301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Subdistrict, Bao'an District, Shenzhen, China |
| Phone Number: | +86-0755-23146130                                                                                                                  |
| Fax Number:   | +86-0755-23146130                                                                                                                  |

### 1.2 Identification of the Responsible Testing Location

|                         |                                                                                                                                                                                                                   |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Location:          | BTF Testing Lab (Shenzhen) Co., Ltd.                                                                                                                                                                              |
| Address:                | 101/201/301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Subdistrict, Bao'an District, Shenzhen, China                                                                                |
| Description:            | All measurement facilities used to collect the measurement data are located at 101/201/301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Subdistrict, Bao'an District, Shenzhen, China |
| FCC Registration Number | 518915                                                                                                                                                                                                            |
| Designation Number      | CN1409                                                                                                                                                                                                            |

### 1.3 Laboratory Condition

|                            |                    |
|----------------------------|--------------------|
| Ambient Temperature:       | 21°C to 25°C       |
| Ambient Relative Humidity: | 48% to 59%         |
| Ambient Pressure:          | 100 kPa to 102 kPa |

### 1.4 Announcement

- (1) The test report reference to the report template version v0.
- (2) The test report is invalid if not marked with the signatures of the persons responsible for preparing, reviewing and approving the test report.
- (3) The test report is invalid if there is any evidence and/or falsification.
- (4) This document may not be altered or revised in any way unless done so by BTF and all revisions are duly noted in the revisions section.
- (5) 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.
- (6) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

## 2. Product Information

### 2.1 Application Information

|               |                                                                                  |
|---------------|----------------------------------------------------------------------------------|
| Company Name: | UNNECTO HOLDING LIMITED                                                          |
| Address:      | 13/F HARBOUR COMMERCIAL BUILDING 122-124 CONNAUGHT ROAD<br>CENTRAL SHEUNG WAN HK |

### 2.2 Manufacturer Information

|               |                                                                            |
|---------------|----------------------------------------------------------------------------|
| Company Name: | COOSEA GROUP (HK) COMPANY LIMITED                                          |
| Address:      | UNIT 503 5/F SILVERCORD TOWER 2 30 CANTON ROAD<br>TSIMSHATSUI KL HONG KONG |

### 2.3 Factory Information

|               |                                                                                                                                           |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Company Name: | Sichuan koobee communication equipment Co., Ltd.                                                                                          |
| Address:      | Building 2, No.69, West of gangyuan Road, Lingang economic and<br>technological development zone, Yibin City, Sichuan Province, P.R.China |

### 2.4 General Description of Equipment under Test (EUT)

|                       |                |
|-----------------------|----------------|
| EUT Name              | Mobile Phone   |
| Under Test Model Name | Bolt 5G        |
| Sample No.            | BTFSN250801010 |

### 2.5 Equipment under Test Ancillary Equipment

|                       |                      |         |
|-----------------------|----------------------|---------|
| Ancillary Equipment 1 | Rechargeable Battery |         |
|                       | Capacity             | 4900mAh |
|                       | Rated Voltage        | 3.87V   |

### 2.6 Technical Information

|                                   |                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Network and Wireless connectivity | 2G Network GSM/GPRS/EGPRS 850/1900<br>3G Network WCDMA/HSDPA/HSUPA Band 2/4/5<br>4G Network FDD LTE Band 2/4/5/7/12/14/17/30/66/71 TDD LTE Band 38/41<br>5G Network FDD NR N2/5/7/12/66/71 TDD NR N41/78<br>2.4G WIFI 802.11b, 802.11g, 802.11n(HT20/40)<br>5G WIFI 802.11a, 802.11n(HT20/40), 802.11ac(VHT20/40/80)<br>Bluetooth (EDR+BLE)<br>NFC |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 2.7 Equipment under Test (EUT) Description

|                 |                                                                                                                                                                                                                                                                                                                                |                                                                                                                                   |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Operating Mode  | GSM, WCDMA, LTE, NR, WLAN, Bluetooth, NFC                                                                                                                                                                                                                                                                                      |                                                                                                                                   |
| Frequency Range | GSM 850                                                                                                                                                                                                                                                                                                                        | 824 MHz ~ 849 MHz                                                                                                                 |
|                 | GSM 1900                                                                                                                                                                                                                                                                                                                       | 1850 MHz ~ 1910 MHz                                                                                                               |
|                 | WCDMA Band 2                                                                                                                                                                                                                                                                                                                   | 1850 MHz ~ 1910 MHz                                                                                                               |
|                 | WCDMA Band 4                                                                                                                                                                                                                                                                                                                   | 1710 MHz ~ 1755 MHz                                                                                                               |
|                 | WCDMA Band 5                                                                                                                                                                                                                                                                                                                   | 824 MHz ~ 849 MHz                                                                                                                 |
|                 | LTE Band 2                                                                                                                                                                                                                                                                                                                     | 1850 MHz ~ 1910 MHz                                                                                                               |
|                 | LTE Band 4                                                                                                                                                                                                                                                                                                                     | 1710 MHz ~ 1755 MHz                                                                                                               |
|                 | LTE Band 5                                                                                                                                                                                                                                                                                                                     | 824 MHz ~ 849 MHz                                                                                                                 |
|                 | LTE Band 7                                                                                                                                                                                                                                                                                                                     | 2500 MHz ~ 2570 MHz                                                                                                               |
|                 | LTE Band 12                                                                                                                                                                                                                                                                                                                    | 699 MHz ~ 716 MHz                                                                                                                 |
|                 | LTE Band 14                                                                                                                                                                                                                                                                                                                    | 788 MHz ~ 798 MHz                                                                                                                 |
|                 | LTE Band 17                                                                                                                                                                                                                                                                                                                    | 704 MHz ~ 716 MHz                                                                                                                 |
|                 | LTE Band 30                                                                                                                                                                                                                                                                                                                    | 2305 MHz ~ 2315 MHz                                                                                                               |
|                 | LTE Band 38                                                                                                                                                                                                                                                                                                                    | 2570 MHz ~ 2620 MHz                                                                                                               |
|                 | LTE Band 41                                                                                                                                                                                                                                                                                                                    | 2496 MHz ~ 2690 MHz                                                                                                               |
|                 | LTE Band 66                                                                                                                                                                                                                                                                                                                    | 1710 MHz ~ 1780 MHz                                                                                                               |
|                 | LTE Band 71                                                                                                                                                                                                                                                                                                                    | 663 MHz ~ 698 MHz                                                                                                                 |
|                 | NR N2                                                                                                                                                                                                                                                                                                                          | 1850 MHz ~ 1910 MHz                                                                                                               |
|                 | NR N5                                                                                                                                                                                                                                                                                                                          | 824 MHz ~ 849 MHz                                                                                                                 |
|                 | NR N7                                                                                                                                                                                                                                                                                                                          | 2500 MHz ~ 2570MHz                                                                                                                |
|                 | NR N12                                                                                                                                                                                                                                                                                                                         | 699 MHz ~ 716 MHz                                                                                                                 |
|                 | NR N41                                                                                                                                                                                                                                                                                                                         | 2496 MHz ~ 2690 MHz                                                                                                               |
|                 | NR N66                                                                                                                                                                                                                                                                                                                         | 1710 MHz ~ 1780 MHz                                                                                                               |
|                 | NR N71                                                                                                                                                                                                                                                                                                                         | 663 MHz ~ 698 MHz                                                                                                                 |
|                 | NR N78                                                                                                                                                                                                                                                                                                                         | 3300 MHz ~ 3550 MHz, 3700 MHz ~ 3800 MHz                                                                                          |
|                 | 802.11b/g/n(HT20)                                                                                                                                                                                                                                                                                                              | 2412 MHz ~ 2462 MHz                                                                                                               |
|                 | 802.11n(HT40)                                                                                                                                                                                                                                                                                                                  | 2422 MHz ~ 2452 MHz                                                                                                               |
|                 | 802.11a<br>/802.11n(HT20/40)<br>/802.11ac(HT20/40/80)                                                                                                                                                                                                                                                                          | U-NII-1: 5180 MHz ~ 5240 MHz,<br>U-NII-2A: 5260 MHz ~ 5320 MHz,<br>U-NII-2C: 5500 MHz ~ 5700 MHz,<br>U-NII-3: 5745 MHz ~ 5825 MHz |
|                 | Bluetooth                                                                                                                                                                                                                                                                                                                      | 2402 ~ 2480 MHz                                                                                                                   |
|                 | NFC                                                                                                                                                                                                                                                                                                                            | 13.56 MHz                                                                                                                         |
| Modulation Mode | GSM/GPRS: GMSK<br>EDGE: 8PSK<br>WCDMA: QPSK, 16QAM<br>LTE: QPSK, 16QAM, 64QAM<br>5G NR: DFT-s-OFDM/CP-OFDM, PI/2 BPSK<br>QPSK, 16QAM, 64QAM, 256QAM<br>802.11b: DSSS<br>802.11a/g: OFDM<br>802.11n-HT20/HT40: OFDM<br>802.11ac-VHT20/40/80/160: OFDM<br>BR+EDR: GFSK, $\pi/4$ -DQPSK, 8-DPSK<br>Bluetooth LE: GFSK<br>NFC: ASK |                                                                                                                                   |

## 2.8 Air Interfaces / Bands Indicating Operating Modes

| Air Interface | Band       | Type | C63.19 RFAIL Tested | Simultaneous Transmitter | Name of Service | Power Reduction |
|---------------|------------|------|---------------------|--------------------------|-----------------|-----------------|
| GSM           | 850        | VO   | Yes                 | WLAN & BT                | CMRS Voice      | No              |
|               | 1900       | VO   | Yes                 | WLAN & BT                | CMRS Voice      | No              |
|               | GPRS/EGPRS | DT   | No                  | N/A                      | N/A             | No              |
| WCDMA         | Band II    | VO   | No                  | WLAN & BT                | CMRS Voice      | No              |
|               | Band IV    | VO   | No                  | WLAN & BT                | CMRS Voice      | No              |
|               | Band V     | VO   | No                  | WLAN & BT                | CMRS Voice      | No              |
|               | HSPA       | DT   | No                  | N/A                      | N/A             | No              |
| LTE           | Band 2     | VD   | No                  | WLAN & BT                | VoLTE           | No              |
|               | Band 4     | VD   | No                  | WLAN & BT                | VoLTE           | No              |
|               | Band 5     | VD   | No                  | WLAN & BT                | VoLTE           | No              |
|               | Band 7     | VD   | No                  | WLAN & BT                | VoLTE           | No              |
|               | Band 12    | VD   | No                  | WLAN & BT                | VoLTE           | No              |
|               | Band 14    | VD   | No                  | WLAN & BT                | VoLTE           | No              |
|               | Band 17    | VD   | No                  | WLAN & BT                | VoLTE           | No              |
|               | Band 30    | VD   | No                  | WLAN & BT                | VoLTE           | No              |
|               | Band 38    | VD   | No                  | WLAN & BT                | VoLTE           | No              |
|               | Band 41    | VD   | No                  | WLAN & BT                | VoLTE           | No              |
|               | Band 66    | VD   | No                  | WLAN & BT                | VoLTE           | No              |
|               | Band 71    | VD   | No                  | WLAN & BT                | VoLTE           | No              |
| NR            | N2         | VD   | No                  | WLAN & BT                | VoNR            | No              |
|               | N5         | VD   | No                  | WLAN & BT                | VoNR            | No              |
|               | N7         | VD   | No                  | WLAN & BT                | VoNR            | No              |
|               | N12        | VD   | No                  | WLAN & BT                | VoNR            | No              |
|               | N41        | VD   | No                  | WLAN & BT                | VoNR            | No              |
|               | N66        | VD   | No                  | WLAN & BT                | VoNR            | No              |
|               | N71        | VD   | No                  | WLAN & BT                | VoNR            | No              |
|               | N78        | VD   | No                  | WLAN & BT                | VoNR            | No              |
| WLAN          | 2.4g&5g    | DT   | No                  | WWAN                     | N/A             | No              |
| BT            | 2450       | DT   | No                  | WWAN                     | N/A             | No              |

NA: Not Applicable

VO: Voice Only

VD: CMRS and IP Voice Service over Digital Transport

DT: Digital Transport Only

Note1: The air interface max power plus MIF is complies with ANSI63.19-2019 Table 4.1 RFAIPL

Note2: According to ANSI C63.19 2019-version, for the air interface technology of a device is exempt from testing whose peak antenna input power, averaged over intervals  $\leq 50 \mu s$ , is  $\leq 23 \text{ dBm}$ .

Note3: The hearing aid compatibility mode of the prototype was turned on during testing, and all tests were performed in HAC mode.

## 2.9 Power Reduction Description

Each qualified transmitter is tested individually using the method of ANSI C63.19-2019 Clause 4. Other WD transmitters shall be temporarily disabled or reduced in power level such that their average antenna input power is at least 6 dB lower than the average antenna input power of the transmitter under test. The transmitter under test is set to the fixed and repeatable combination of power and modulation characteristic that is representative of the worst case (highest interference potential) likely to be encountered while the WD is experiencing normal voice mode operation.

The limiting measurement for device qualification is the highest RF audio interference potential measured for any of the WD transmitters. If the highest interference measurement is from a transmitter that is not required for normal voice mode operation, a secondary rating may be given that applies when that transmitter is disabled.

Note: The device does not support power reduction for HAC mode, so we do not need to consider the case of power reduction.

## 3. Summary of Test Results

### 3.1 Test Standards

| No. | Identity          | Document Title                                                                                                                 |
|-----|-------------------|--------------------------------------------------------------------------------------------------------------------------------|
| 1   | ANSI C63.19-2019  | American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids |
| 2   | FCC 47 CFR §20.19 | Hearing Aid Compatible Mobile Headsets                                                                                         |
| 3   | KDB 285076 D01    | HAC Guidance v06r04                                                                                                            |
| 4   | KDB 285076 D02    | T-Coil testing for CMRS IP v04                                                                                                 |
| 5   | KDB 285076 D03    | HAC FAQ v01r06                                                                                                                 |

### 3.2 Summary of HAC result

| Band    | Channel     | Measurement Result |              |
|---------|-------------|--------------------|--------------|
| GSM850  | Low (128)   | E-Field dB (V/m)   | 32.53        |
|         | Middle(190) | E-Field dB (V/m)   | 33.69        |
|         | High(251)   | E-Field dB (V/m)   | <b>34.44</b> |
| GSM1900 | Low (512)   | E-Field dB (V/m)   | 32.52        |
|         | Middle(661) | E-Field dB (V/m)   | 33.12        |
|         | High(810)   | E-Field dB (V/m)   | <b>33.36</b> |

### 3.3 HAC Test Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in ANSI C6 3.19-2019. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

| UNCERTAINTY EVALUATION FOR RF HAC MEASUREMENT                        |                    |             |            |                  |                 |
|----------------------------------------------------------------------|--------------------|-------------|------------|------------------|-----------------|
| Uncertainty Component                                                | Tol<br>( $\pm$ dB) | Prob. Dist. | Div.       | Uncertainty (dB) | Uncertainty (%) |
| Measurement System                                                   |                    |             |            |                  |                 |
| RF reflections                                                       | 0.1                | R           | $\sqrt{3}$ | 0.06             |                 |
| Field probe conv. Factor                                             | 0.4                | R           | $\sqrt{3}$ | 0.23             |                 |
| Field probe anisotropy                                               | 0.25               | R           | $\sqrt{3}$ | 0.14             |                 |
| Positioning accuracy                                                 | 0.2                | R           | $\sqrt{3}$ | 0.12             |                 |
| Probe cable placement                                                | 0.1                | R           | $\sqrt{3}$ | 0.06             |                 |
| System repeatability                                                 | 0.2                | R           | $\sqrt{3}$ | 0.12             |                 |
| EUT repeatability                                                    | 0.4                | N           | 1          | 0.40             |                 |
| Combined Standard Uncertainty                                        |                    | N           | 1          | 0.52             |                 |
| Expanded Uncertainty<br>(95% CONFIDENCE INTERVAL)                    |                    | N           | $K=2$      | 1.03             | 12.65           |
| REPORTED Expanded uncertainty<br>(confidence level of 95%, $k = 2$ ) |                    | N           | $K=2$      | 1.00             | 13.00           |

## 4. Measurement System

### 4.1 Definition of Hearing Aid Compatibility (HAC)

The purpose of this standard is to establish categories for hearing aids and for WD (wireless communications devices) that can indicate to health care practitioners and hearing aid users which hearing aids are compatible with which WD, and to provide tests that can be used to assess the electromagnetic characteristics of hearing aids and WD and assign them to these categories. The various parameters required, in order to demonstrate compatibility and accessibility are measured. The design of the standard is such that when a hearing aid and WD achieve one of the categories specified, as measured by the methodology of this standard, the indicated performance is realized.

In order to provide for the usability of a hearing aid with a WD, several factors must be coordinated:

- a) Radio frequency (RF) measurements of the near-field electric and magnetic fields emitted by a WD to categorize these emissions for correlation with the RF immunity of a hearing aid.
- b) Magnetic field measurements of a WD emitted via the audio transducer associated with the T-coil mode of the hearing aid, for assessment of hearing aid performance.
- c) Measurements with the hearing aid and a simulation of the categorized WD T-coil emissions to assess the hearing aid RF immunity in the T-coil mode.

The WD radio frequency (RF) and audio band emissions are measured.

Hence, the following are measurements made for the WD:

- a) RF E-Field emissions
- b) T-coil mode, magnetic signal strength in the audio band
- c) T-coil mode, magnetic signal and noise articulation index
- d) T-coil mode, magnetic signal frequency response through the audio band

Corresponding to the WD measurements, the hearing aid is measured for:

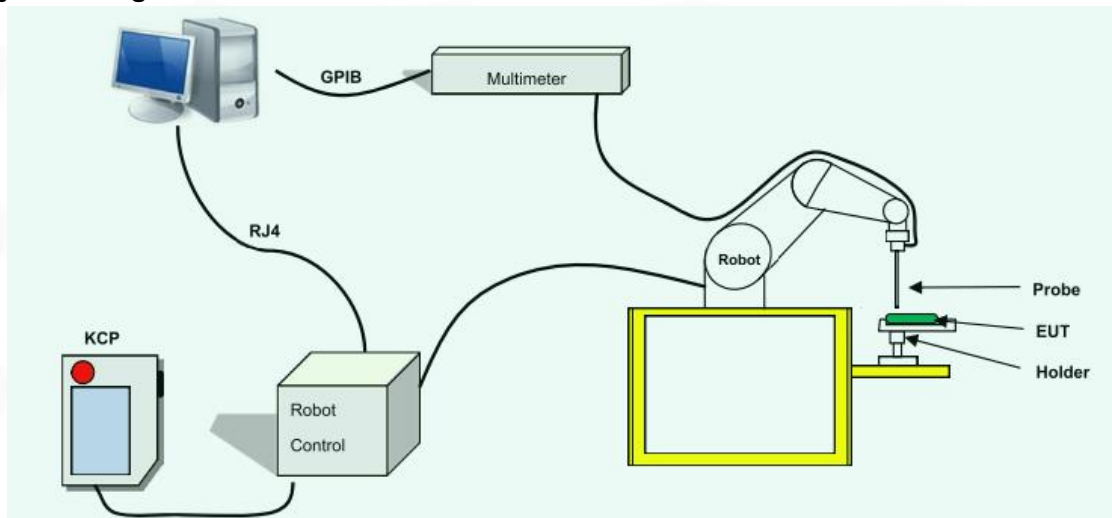
- a) RF immunity in microphone mode
- b) RF immunity in T-coil mode

## 4.2 HAC RF Test Configuration and Setting

For HAC RF emission testing, the EUT was linked and controlled by wireless communication test set. Communication between the EUT and the wireless communication test set was established by air link. The distance between the EUT and the communicating antenna of the test set is larger than 50 cm and the output power radiated from the wireless communication test set antenna is at least 30 dB smaller than the output power of EUT. The EUT was set from the wireless communication test set to radiate maximum output power during HAC testing.

## 4.3 MVG HAC System

MVG HAC System Diagram



#### 4.3.1 Robot



A standard high precision 6-axis robot (Denso) with a scanning system

- It must be able to scan all the volume of the phantom to evaluate the tridimensional distribution of SAR.
- Must be able to set the probe orthogonal to the surface of the phantom ( $\pm 30^\circ$ ).
- Detects stresses on the probe and stop itself if necessary to keep the integrity of the probe.

#### 4.3.2 E-Field Probe

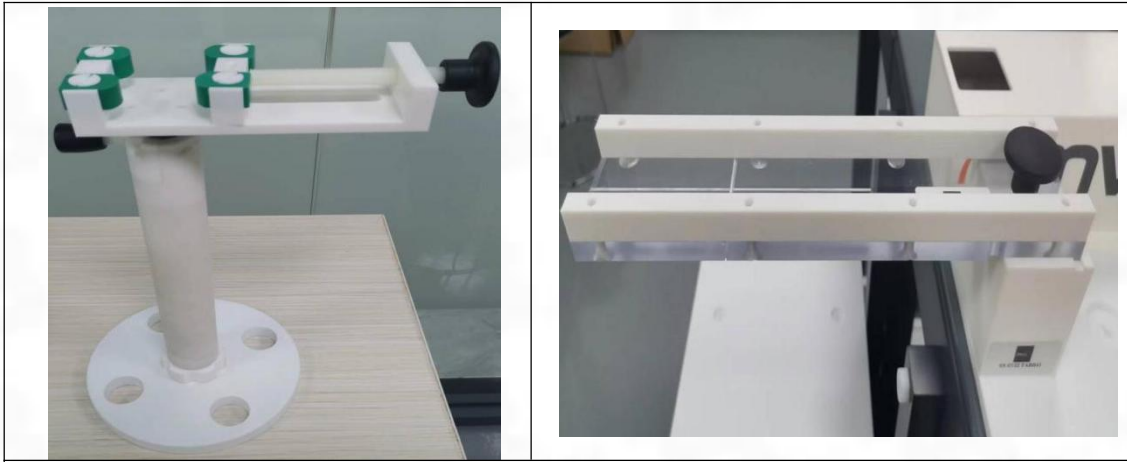


Figure 1 – MVG COMOHAC E field Probe

|                                            |        |
|--------------------------------------------|--------|
| Probe Length                               | 330 mm |
| Length of Individual Dipoles               | 3.3 mm |
| Maximum external diameter                  | 8 mm   |
| Probe Tip External Diameter                | 5 mm   |
| Distance between dipoles / probe extremity | 3 mm   |

|                                          |                                                                         |
|------------------------------------------|-------------------------------------------------------------------------|
| Device Type                              | COMOHAC E FIELD PROBE                                                   |
| Manufacturer                             | MVG                                                                     |
| Model                                    | SCE                                                                     |
| Serial Number                            | SN 07/22 EPH50                                                          |
| Product Condition (new / used)           | New                                                                     |
| Frequency Range of Probe                 | 0.7GHz-2.5GHz                                                           |
| Resistance of Three Dipoles at Connector | Dipole 1: R1=0.208 MΩ<br>Dipole 2: R2=0.220 MΩ<br>Dipole 3: R3=0.212 MΩ |

#### 4.3.3 Device Holder/DUT positioner



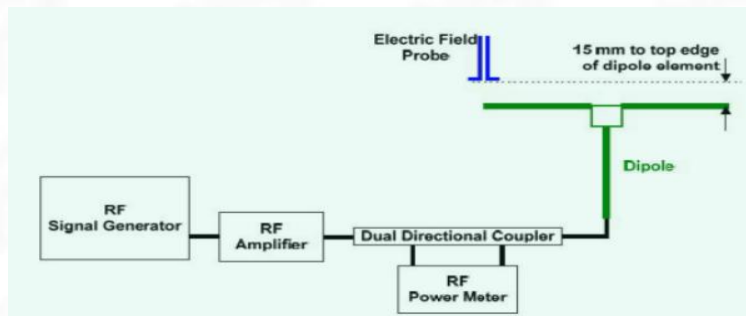
During test, use DUT positioner adjust DUT to check if the Speaker is aligned with the positioner center.

## 5. System Validation

According to ANSI C63.19, before hearing aid testing commences, the experimental setup shall be validated. Sub clauses 6.3.1 through 6.3.5 include a set of pretest procedures designed to validate the experimental setup to ensure the accuracy of the results. To verify that the hearing aid performs per the manufacturer's specifications, 6.3.5 advises that the hearing aid be pretested per ANSI S3.22.

### 5.1 System Validation Setup

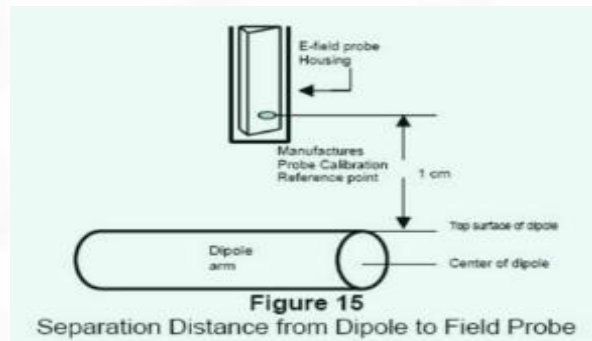
Using this setup configuration, the signal generator was adjusted for the desired output power 20dBm (100mW) at a specified frequency. The reference power from the coupled port of the directional coupler is recorded. Next, the output cable is connected to the reference dipole



### 5.2 System Check Procedure

The input signal was an unmodulated continuous wave. The following points were taken into consideration in performing this check:

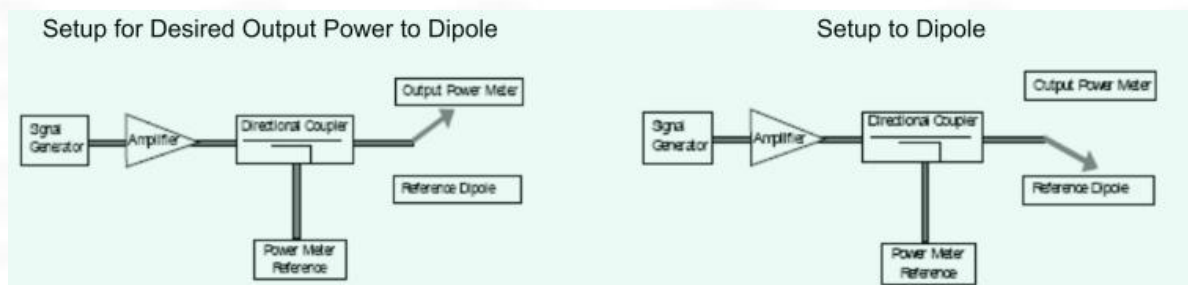
- Average Input Power  $P = 100\text{mW RMS}$  (20dBm RMS) after adjustment for return loss
- The test fixture must meet the 2 wavelength separation criterion
- The proper measurement of the 1 cm probe to dipole separation, which is measured from top surface of the dipole to the calibration reference point of the sensor, defined by the probe manufacturer is shown in the following diagram:



RF power was recorded using both an average reading meter and a peak reading meter. Readings of the probe are provided by the measurement system. To assure proper operation of the near-field measurement probe the input power to the dipole shall be commensurate with the full rated output power of the wireless device (e.g. – for a cellular phone wireless device the average peak antenna input power will be on the order of 100mW (i.e. - 20dBm) RMS after adjustment for any mismatch.

### 5.3 System Validation Procedure

A dipole antenna meeting the requirements given in C63.19 was placed in the position normally occupied by the WD. The length of the dipole was scanned with both E-field and H-field probes and the maximum values for each were recorded. Using the near-field measurement system, scan the antenna over the radiating dipole and record the greatest field reading observed. Due to the nature of E-fields about free-space dipoles, the two E-field peaks measured over the dipole are averaged to compensate for non-parallelity of the setup see manufacturer method on dipole calibration certificates, Field strength measurements shall be made only when the probe is stationary. RF power was recorded using both an average and a peak power reading meter.



## 6. WD emission requirements

The WD's conducted power must be at or below either the stated RFAIPL (Table 1.1) or the stated peak power level (Table 1.2), or the average near-field emissions over the measurement area must be at or below the stated RFAIL (Table 1.3), or the stated peak field strength (Table 1.4). The WD may demonstrate compliance by meeting any of these four requirements, but it must do so in each of its operating bands at its established worst-case normal speech- mode operating condition.

Table 1.1—Wireless device RF audio interference power level

| Frequency range (MHz) | RFAIPL (dBm) |
|-----------------------|--------------|
| <960                  | 29           |
| 960-2000              | 26           |
| >2000                 | 25           |

Table 1.2—Wireless device RF peak power level

| Frequency range (MHz) | RFpeak Power (dBm) |
|-----------------------|--------------------|
| <960                  | 35                 |
| 960-2000              | 32                 |
| >2000                 | 31                 |

Table 1.3—Wireless device RF audio interference level

| Frequency range (MHz) | RFAIL [dB(V/m)] |
|-----------------------|-----------------|
| <960                  | 39              |
| 960-2000              | 36              |
| >2000                 | 35              |

Table 1.4-Wireless device RF peak near-field level

| Frequency range (MHz) | RFpeak [dB(V/m)] |
|-----------------------|------------------|
| <960                  | 45               |
| 960-2000              | 42               |
| >2000                 | 41               |

## 7. Modulation Interference Factor (MIF)

The HAC Standard ANSI C63.19-2019 defines a new scaling using the Modulation Interference Factor (MIF). For any specific fixed and repeatable modulated signal, a modulation interference factor (MIF, expressed in dB) may be developed that relates its interference potential to its steady-state rms signal level or average power level. This factor is a function only of the audio-frequency amplitude modulation characteristics of the signal and is the same for field-strength and conducted power measurements. It is important to emphasize that the MIF is valid only for a specific repeatable audio-frequency amplitude modulation characteristic. Any change in modulation characteristic requires determination and application of a new MIF.

The MIF may be determined using a radiated RF field, a conducted RF signal, or in a preliminary stage, a mathematical analysis of a modeled RF signal:

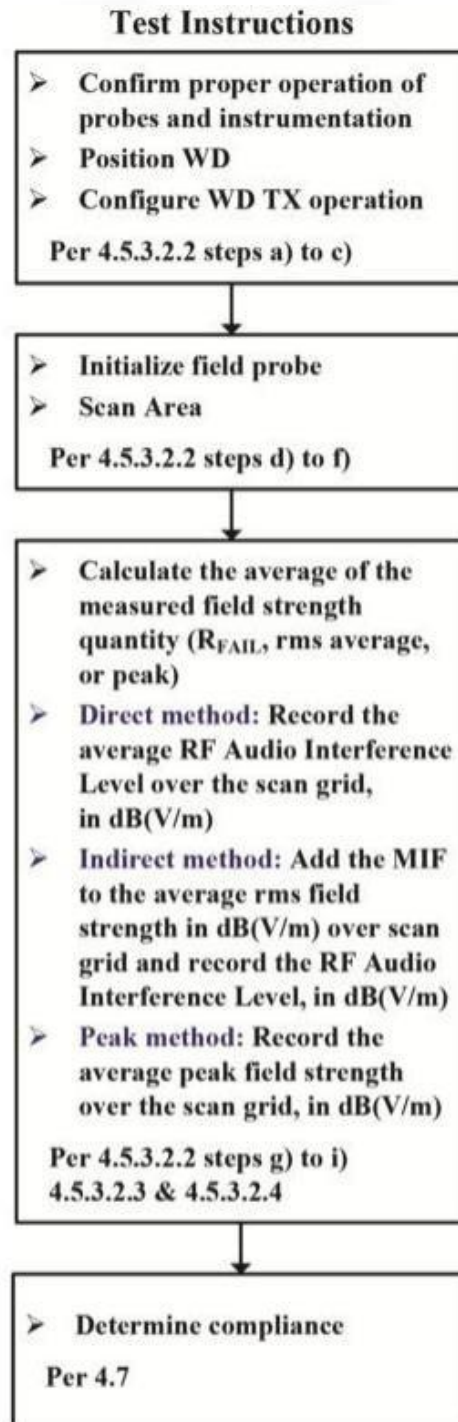
- Verify the slope accuracy and dynamic range capability over the desired operating frequency band of a fast probe or sensor, square-law detector, as specified in D.3, and weighting system as specified in D.4 and D.5. For the probe and instrumentation included in the measurement of MIF, additional calibration and application of calibration factors are not required.
- Using RF illumination or conducted coupling, apply the specific modulated signal in question to the measurement system at a level within its confirmed operating dynamic range.
- Measure the steady-state rms level at the output of the fast probe or sensor.
- Measure the steady-state average level at the weighting output.
- Without changing the square-law detector or weighting system, and using RF illumination or conducted coupling, substitute for the specific modulated signal a 1 kHz, 80% amplitude-modulated carrier at the same frequency and adjust its strength until the level at the weighting output equals the step d) measurement.
- Without changing the carrier level from step e), remove the 1 kHz modulation and again measure the steady-state rms level indicated at the output of the fast probe or sensor.
- The MIF for the specific modulation characteristic is provided by the ratio of the step f) measurement to the step c) measurement, expressed in dB ( $20 \times \log(\text{step f}) / \text{step c})$ ).

In practice, step e) and step f) need not be repeated for each MIF determination if the relationship between the two measurements has been preestablished for the measurement system over the operating frequency and dynamic ranges.

| Modulation group | Modulation characteristics                                | MIF    |
|------------------|-----------------------------------------------------------|--------|
| GSM              | TDMA                                                      | 3.3    |
| WCDMA            | UMTS-FDD                                                  | -27.2  |
| LTE              | LTE-FDD / RB=1 / BW=20 MHz / QPSK                         | -15.6  |
|                  | LTE-TDD / RB=1 / BW=20 MHz / QPSK                         | -1.6   |
| NR               | 5G NR 100% duty (CP-OFDM, 1 RB, 15 MHz, QPSK, 15 kHz)     | -12.08 |
|                  | 5G NR 40% duty ((DFT-S-OFDM, 1 RB, 100 MHz, QPSK, 30 kHz) | -3.64  |
| 2.4G WiFi        | IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)                 | -2.02  |
|                  | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)            | 0.12   |
| 5G WiFi          | IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)     | -5.59  |
|                  | IEEE 802.11a/n WiFi 5 GHz (OFDM, 54 Mbps)                 | -3.15  |
|                  | IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)         | -5.57  |
| Bluetooth        | IEEE 802.15.1 Bluetooth (GFSK, DH1)                       | 1.0    |

## 8. HAC Immunity Measurement Procedures

### 8.1 HAC Measurement Process Diagram



## 8.2 HAC RF Test Setup



WD reference and plane for RF emission measurements

## 8.3 RF Emission Measurement Procedures: indirect measurement-preferred

- The measurement procedure using a probe and instrumentation chain with a response of <10 kHz (see ANSI63.19-2019 section 4.5.1) is identical to the direct measurement method of ANSI63.19-2019 section 4.5.3.2.2: however, because of the bandwidth limitations, it cannot include the direct use of the spectral and temporal weighting functions. The output of such measurement systems must be readings of steady state rms field strength in dB(V/m).
- The RF audio interference level in dB(Vim) is obtained by adding the Modulation Interference Factor (in decibels) to the average steady state rms field strength reading over the measurement area, in dB(V/m), from Step c). Use this result to determine the WD's compliance per ANSI 63.19-2019 section 4.7.
- The measurement area shall be centered on the acoustic output or the T-Coil mode measurement reference point, as appropriate. Locate the field probe at the initial test position in the 50 mm by 50 mm measurement area, which is contained in the measurement plane described in ANSI 63.19-2019 section 4.5.2 and illustrated in Figure A.1. If the field alignment method is used, align the probe for maximum field reception.
- Record the reading at the output of the measurement system.
- Scan the entire 50 mm by 50 mm measurement area in equally spaced step sizes and record the reading at each measurement point. The step size shall meet the specification for step size in ANSI 63.19-2019 section 4.5.3.
- Calculate the average of the measurements taken in Step f).
- Convert the average value found in Step g) to RF audio interference level, in volts per meter, by taking the square root of the reading and then dividing it by the measurement system transfer function, as established in ANSI 63.19-2019 section 4.5.3.2.1 pre-test procedure. Convert the result to dB(V/m) by taking the base-10 logarithm and multiplying it by 20. Expressed as a formula:

$$\text{RF audio interference level in dB(V/M)} = 20 \times \log(R_{\text{ave}}^{1/2} / \text{TF})$$

where

$R_{\text{ave}}$  is the average reading

- Compare this RF audio interference level to the limits in 6 and record the result.

## 9. Low-Power Exemption

### 9.1 Tune-up Power

| Mode        | Tune-up Power (dBm) |
|-------------|---------------------|
| GSM 850     | 35.00               |
| GSM 1900    | 26.50               |
| WCDMA II    | 17.00               |
| WCDMA IV    | 17.00               |
| WCDMA V     | 25.50               |
| LTE Band 2  | 17.50               |
| LTE Band 4  | 18.00               |
| LTE Band 5  | 25.00               |
| LTE Band 7  | 16.50               |
| LTE Band 12 | 26.00               |
| LTE Band 14 | 19.00               |
| LTE Band 17 | 25.50               |
| LTE Band 30 | 17.00               |
| LTE Band 38 | 22.00               |
| LTE Band 41 | 25.00               |
| LTE Band 66 | 18.00               |
| LTE Band 71 | 25.50               |
| NR N2       | 16.00               |
| NR N5       | 24.20               |
| NR N7       | 15.30               |
| NR N12      | 24.20               |
| NR N41      | 20.50               |
| NR N66      | 17.00               |
| NR N71      | 24.00               |
| NR N78      | 15.00               |
| 2.4G WIFI   | 15.00               |
| 5.2G WIFI   | 8.50                |
| 5.3G WIFI   | 8.30                |
| 5.6G WIFI   | 8.80                |
| 5.8G WIFI   | 8.30                |
| Bluetooth   | 4.50                |

## 9.2 RF Emissions Lower Power Exemption

| Mode                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Tune-up Power (dBm) | MIF    | Power + MIF(dB) | C63.19 Lowest RFAIPL(dBm) | C63.19 Test Required? |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------|-----------------|---------------------------|-----------------------|
| GSM 850                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 35.00               | 3.30   | 38.30           | 29.00                     | Yes                   |
| GSM 1900                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 26.50               | 3.30   | 29.80           | 26.00                     | Yes                   |
| WCDMA II                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 17.00               | -27.20 | -10.20          | 26.00                     | No                    |
| WCDMA IV                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 17.00               | -27.20 | -10.20          | 26.00                     | No                    |
| WCDMA V                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 25.50               | -27.20 | -1.70           | 29.00                     | No                    |
| LTE Band 2                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 17.50               | -15.60 | 1.90            | 26.00                     | No                    |
| LTE Band 4                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 18.00               | -15.60 | 2.40            | 26.00                     | No                    |
| LTE Band 5                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 25.00               | -15.60 | 9.40            | 29.00                     | No                    |
| LTE Band 7                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 16.50               | -15.60 | 0.90            | 26.00                     | No                    |
| LTE Band 12                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 26.00               | -15.60 | 10.40           | 29.00                     | No                    |
| LTE Band 14                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 19.00               | -15.60 | 3.40            | 29.00                     | No                    |
| LTE Band 17                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 25.50               | -15.60 | 9.90            | 29.00                     | No                    |
| LTE Band 30                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 17.00               | -15.60 | 1.40            | 25.00                     | No                    |
| LTE Band 38                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 22.00               | -1.60  | 20.40           | 25.00                     | No                    |
| LTE Band 41                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 25.00               | -1.60  | 23.40           | 25.00                     | No                    |
| LTE Band 66                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 18.00               | -15.60 | 2.40            | 26.00                     | No                    |
| LTE Band 71                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 25.50               | -15.60 | 9.90            | 29.00                     | No                    |
| NR N2                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 16.00               | -12.08 | 3.92            | 26.00                     | No                    |
| NR N5                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 24.20               | -12.08 | 12.12           | 29.00                     | No                    |
| NR N7                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 15.30               | -12.08 | 3.22            | 25.00                     | No                    |
| NR N12                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 24.20               | -12.08 | 12.12           | 29.00                     | No                    |
| NR N41                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 20.50               | -3.64  | 16.86           | 25.00                     | No                    |
| NR N66                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 17.00               | -12.08 | 4.92            | 26.00                     | No                    |
| NR N71                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 24.00               | -12.08 | 11.92           | 29.00                     | No                    |
| NR N78                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 15.00               | -3.64  | 11.36           | 25.00                     | No                    |
| 2.4G WIFI                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 15.00               | -2.02  | 12.98           | 25.00                     | No                    |
| 5.2G WIFI                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 8.50                | -5.57  | 2.93            | 25.00                     | No                    |
| 5.3G WIFI                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 8.30                | -5.59  | 2.71            | 25.00                     | No                    |
| 5.6G WIFI                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 8.80                | -5.57  | 3.23            | 25.00                     | No                    |
| 5.8G WIFI                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 8.30                | -5.57  | 2.73            | 25.00                     | No                    |
| BT                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 4.50                | 1.00   | 5.50            | 25.00                     | No                    |
| Note:<br>1. Use maximum power plus worst case MIF to determine whether it complies with RFAIPL.<br>2. If maximum power plus worst case MIF does not comply with RFAIPL, then further evaluation RFAIPL include in section 11.2.<br>3. EDGE data modes is not necessary due the GSM Voice mode is the worst case.<br>4. According to ANSI C63.19 2019, if maximum power plus worst case MIF is complies with RFAIPL, means compliance with WD emission requirements. |                     |        |                 |                           |                       |

## 10. Test Equipment List

| Description                           | Manufacturer      | Model         | Serial No./Version | Cal. Date  | Cal. Due   |
|---------------------------------------|-------------------|---------------|--------------------|------------|------------|
| PC                                    | Dell              | N/A           | N/A                | N/A        | N/A        |
| Test Software                         | MVG               | N/A           | OpenHAC V5.1.3     | N/A        | N/A        |
| COMOHAC E-field Probe                 | MVG               | SCE           | 07/22 EPH50        | 2025/02/05 | 2026/02/04 |
| COMOHAC 800-950MHz reference dipole   | MVG               | SIDB835       | 07/22 DHA69        | 2025/05/27 | 2028/05/26 |
| COMOHAC 1700-2000MHz reference dipole | MVG               | SIDB1900      | 07/22 DHB70        | 2025/05/27 | 2028/05/26 |
| 6 1/2 Digital Multimeter              | Keithley          | DMM6500       | 4527164            | 2024/10/25 | 2025/10/24 |
| MXG Vector Signal Generator           | Agilent           | N5182A        | MY46240163         | 2024/10/25 | 2025/10/24 |
| E-Series Avg. Power Sensor            | KEYSIGHT          | E9300A        | MY55050017         | 2025/04/02 | 2026/04/01 |
| EPM Series Power Meter                | KEYSIGHT          | E4418B        | MY41293435         | 2025/04/02 | 2026/04/01 |
| 10DB Attenuator                       | MIDWEST MICROWAVE | 263-10dB      | /                  | 2025/04/02 | 2026/04/01 |
| Coupler                               | MERRIMAC          | CWM-10R-10.8G | LOT-83391          | 2024/10/25 | 2025/10/24 |
| Wideband Radio Communication Tester   | ROHDE & SCHWARZ   | CMW500        | 161997             | 2024/10/25 | 2025/10/24 |

## ANNEX A HAC RF System Validation Result

| E-Field Scan |                 |                  |                        |                    |                      |               |           |
|--------------|-----------------|------------------|------------------------|--------------------|----------------------|---------------|-----------|
| Mode         | Frequency (MHz) | Input Power (mW) | Measured Value (dBV/m) | Target Value (V/m) | Target Value (dBV/m) | Deviation (%) | Limit (%) |
| CW           | 835             | 100              | 46.83                  | 216.91             | 46.73                | -0.30%        | ±10       |
| CW           | 1900            | 100              | 42.96                  | 147.01             | 43.35                | -1.51%        | ±10       |

### System check at 835.00 MHz

Date of measurement: 18/9/2025

### Experimental Conditions

|                 |               |
|-----------------|---------------|
| Probe           | SN_0722_EPH50 |
| Signal          | CW            |
| Band            | CW835         |
| Channels        | middle        |
| Channels Number | -             |
| Frequency (MHz) | 835.00        |

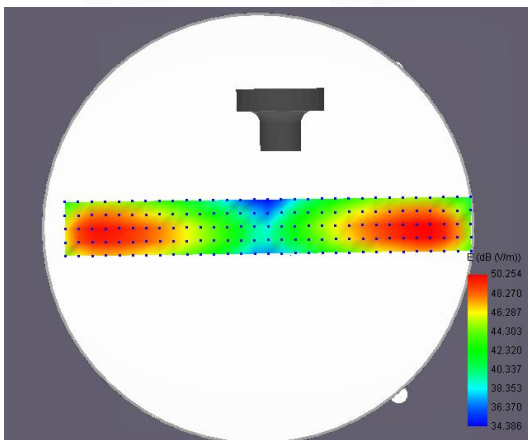
### Results

|                                 |       |
|---------------------------------|-------|
| E-field average [dB(V/m)]       | 46.83 |
| Right E-field maximum [dB(V/m)] | 46.70 |
| Left E-field maximum [dB(V/m)]  | 46.95 |

### Scan parameter

|                                              |               |
|----------------------------------------------|---------------|
| Scan area: length (mm), width (mm)           | 20.00, 150.00 |
| Measurement point spacing (mm)               | 5             |
| distance to reference plane (mm)             | 8.00          |
| X and Y offset with the reference point (mm) | 0.00, 0.00    |
| Number of measurement points                 | 155           |

### RF audio interference near field



## System check at 1900.00 MHz

Date of measurement: 18/9/2025

## Experimental Conditions

|                 |               |
|-----------------|---------------|
| Probe           | SN_0722_EPH50 |
| Signal          | CW            |
| Band            | CW1900        |
| Channels        | middle        |
| Channels Number | -             |
| Frequency (MHz) | 1900.00       |

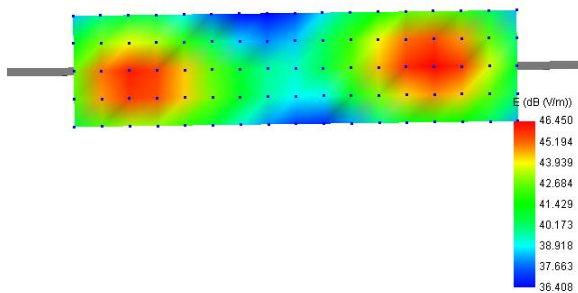
## Results

|                                 |       |
|---------------------------------|-------|
| E-field average [dB(V/m)]       | 42.96 |
| Right E-field maximum [dB(V/m)] | 42.77 |
| Left E-field maximum [dB(V/m)]  | 43.15 |

## Scan parameter

|                                              |              |
|----------------------------------------------|--------------|
| Scan area: length (mm), width (mm)           | 20.00, 80.00 |
| Measurement point spacing (mm)               | 5            |
| distance to reference plane (mm)             | 8.00         |
| X and Y offset with the reference point (mm) | 0.00, 0.00   |
| Number of measurement points                 | 85           |

## RF audio interference near field



## ANNEX B HAC RF Measurement Result

| Band    | Channel     | Frequency (MHz) | RF audio interference level [dB(V/m)] | Device compliant | Plot |
|---------|-------------|-----------------|---------------------------------------|------------------|------|
| GSM850  | Low (128)   | 824.2MHz        | 32.53                                 | Yes              | /    |
|         | Middle(190) | 836.6MHz        | 33.69                                 | Yes              | /    |
|         | High(251)   | 848.8MHz        | <b>34.44</b>                          | Yes              | 1#   |
| GSM1900 | Low (512)   | 1850.2MHz       | 32.52                                 | Yes              | /    |
|         | Middle(661) | 1880.0MHz       | 33.12                                 | Yes              | /    |
|         | High(810)   | 1909.8MHz       | <b>33.36</b>                          | Yes              | 2#   |

### Measurement at GSM850

Date of measurement: 18/9/2025

### Experimental Conditions

|                 |               |
|-----------------|---------------|
| Probe           | SN_0722_EPH50 |
| Signal          | GSM           |
| Band            | GSM850        |
| Channels        | high          |
| Channels Number | 251           |
| Frequency (MHz) | 848.80        |
| MIF             | 3.30          |

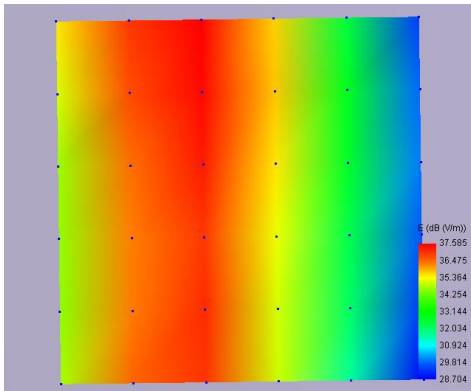
### Results

|                                       |          |
|---------------------------------------|----------|
| RF audio interference level [dB(V/m)] | 34.44    |
| Device compliant                      | Yes      |
| Measurement status                    | Complete |

### Scan parameter

|                                              |              |
|----------------------------------------------|--------------|
| Scan area: length (mm), width (mm)           | 50.00, 50.00 |
| Measurement point spacing (mm)               | 10           |
| distance to reference plane (mm)             | 15.00        |
| X and Y offset with the reference point (mm) | 0.00, 0.00   |
| Number of measurement points                 | 36           |

### RF audio interference near field



## Measurement at GSM1900

Date of measurement: 18/9/2025

### Experimental Conditions

|                 |               |
|-----------------|---------------|
| Probe           | SN_0722_EPH50 |
| Signal          | GSM           |
| Band            | GSM1900       |
| Channels        | high          |
| Channels Number | 810           |
| Frequency (MHz) | 1909.80       |
| MIF             | 3.30          |

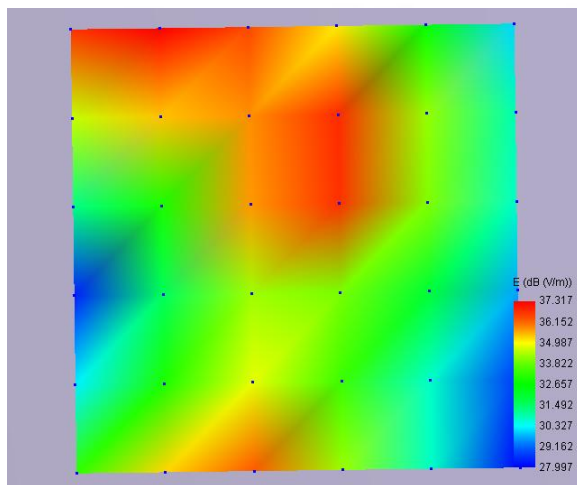
### Results

|                                       |          |
|---------------------------------------|----------|
| RF audio interference level [dB(V/m)] | 33.36    |
| Device compliant                      | Yes      |
| Measurement status                    | Complete |

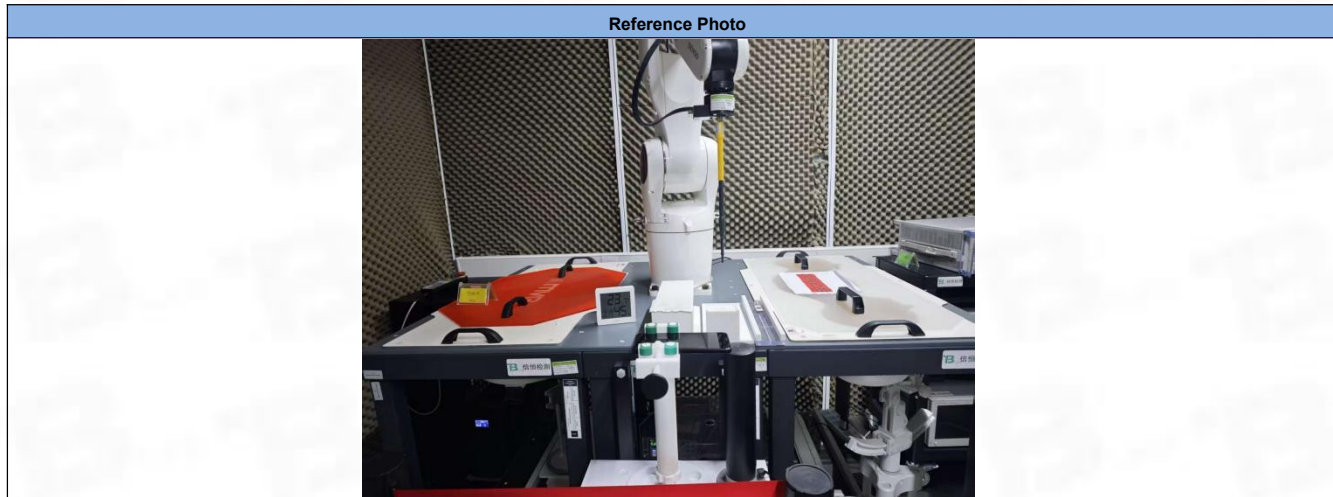
### Scan parameter

|                                              |              |
|----------------------------------------------|--------------|
| Scan area: length (mm), width (mm)           | 50.00, 50.00 |
| Measurement point spacing (mm)               | 10           |
| distance to reference plane (mm)             | 15.00        |
| X and Y offset with the reference point (mm) | 0.00, 0.00   |
| Number of measurement points                 | 36           |

### RF audio interference near field



## ANNEX C Test Setup Photos



## ANNEX D EUT External & Internal Photos

Please refer to RF Report.

## ANNEX E Calibration Information

Please refer to the document "Calibration.pdf".



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**--END OF REPORT--**