



## SGS-CSTC Standards Technical Services Co., Ltd. Suzhou Branch

Report No.: SUCR240600020104

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# HAC (Volume Control) Test Report

|                              |                                                                                                                                 |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <b>Application No.:</b>      | SUCR2406000201WM                                                                                                                |
| <b>FCC ID:</b>               | WYPS6002                                                                                                                        |
| <b>Applicant:</b>            | Sonim Technologies, Inc.                                                                                                        |
| <b>Applicant Address:</b>    | 4445 Eastgate Mall, Suite 200, San Diego, CA 92121, USA                                                                         |
| <b>Manufacturer:</b>         | Sonim Technologies, Inc.                                                                                                        |
| <b>Manufacturer Address:</b> | 4445 Eastgate Mall, Suite 200, San Diego, CA 92121, USA                                                                         |
| <b>Product Name:</b>         | Smartphone                                                                                                                      |
| <b>Model No.(EUT):</b>       | X800                                                                                                                            |
| <b>Type No.:</b>             | S6002                                                                                                                           |
| <b>Trademark:</b>            | Sonim                                                                                                                           |
| <b>Standards:</b>            | ANSI C63.19-2019<br>ANSI/TIA-5050-2018<br>47CFR Part 20.19<br>KDB 285076 D01 v06r04<br>KDB 285076 D04 v02<br>KDB 285076 D05 v01 |
| <b>Date of Receipt:</b>      | 2024/06/19                                                                                                                      |
| <b>Date of Test:</b>         | 2024/06/20 to 2024/08/20                                                                                                        |
| <b>Date of Issue:</b>        | 2024/08/27                                                                                                                      |
| <b>Test conclusion:</b>      | <b>PASS *</b>                                                                                                                   |

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

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| Revision Record |             |            |        |
|-----------------|-------------|------------|--------|
| Version         | Description | Date       | Remark |
| 00              | Original    | 2024-08-27 | /      |
|                 |             |            |        |

|                          |  |                             |  |  |
|--------------------------|--|-----------------------------|--|--|
| Authorized for issue by: |  |                             |  |  |
| Tested By                |  | Hainan Sun                  |  |  |
|                          |  | Hainan Sun/Project Engineer |  |  |
| Approved By              |  | Nada Cao                    |  |  |
|                          |  | Nada Cao/Reviewer           |  |  |

## 2 Test Summary of Minimum Conversational Gain

| Mode                        | Band      | Conv. Gain (dB) |       | Limit (dB) | Result |
|-----------------------------|-----------|-----------------|-------|------------|--------|
|                             |           | 2N              | 8N    |            |        |
| GSM                         | 850       | 7.47            | 12.71 | ≥6         | Pass   |
|                             | 1900      | 7.52            | 12.69 |            | Pass   |
| WCDMA                       | II        | 7.02            | 12.06 |            | Pass   |
|                             | IV        | 7.13            | 12.1  |            | Pass   |
|                             | V         | 7.19            | 12.27 |            | Pass   |
| LTE                         | 2         | 7.06            | 12.09 |            | Pass   |
|                             | 4         | 7.25            | 12.19 |            | Pass   |
|                             | 5         | 7.14            | 11.81 |            | Pass   |
|                             | 7         | 7.16            | 12    |            | Pass   |
|                             | 12        | 6.93            | 11.89 |            | Pass   |
|                             | 13        | 6.71            | 11.99 |            | Pass   |
|                             | 14        | 6.61            | 11.93 |            | Pass   |
|                             | 25        | 6.87            | 11.96 |            | Pass   |
|                             | 26        | 6.97            | 11.85 |            | Pass   |
|                             | 30        | 7.03            | 12.1  |            | Pass   |
|                             | 38        | 6.93            | 11.89 |            | Pass   |
|                             | 41        | 7.02            | 11.94 |            | Pass   |
|                             | 42        | 6.93            | 11.86 |            | Pass   |
|                             | 48        | 6.92            | 11.95 |            | Pass   |
|                             | 66        | 6.93            | 11.84 |            | Pass   |
|                             | 71        | 7.04            | 12.17 |            | Pass   |
|                             | WLAN-2.4G | 802.11b         | 6.95  |            | 11.87  |
| 802.11g                     |           | 6.91            | 11.72 |            | Pass   |
| 802.11n                     |           | 7.08            | 11.7  |            | Pass   |
| 802.11ax                    |           | 7.01            | 11.79 |            | Pass   |
| WLAN-5G                     | 802.11a   | 6.9             | 11.26 |            | Pass   |
|                             | 802.11n   | 6.6             | 11.28 |            | Pass   |
|                             | 802.11ac  | 6.63            | 11.47 |            | Pass   |
|                             | 802.11ax  | 6.8             | 11.38 |            | Pass   |
| WLAN-6E                     | 802.11ax  | 6.81            | 11.51 |            | Pass   |
| Minimum Conversational Gain |           |                 |       |            | Pass   |

### 3 Contents

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## 4 General Information

### 4.1 General Description of EUT

|                   |                        |             |             |
|-------------------|------------------------|-------------|-------------|
| IMEI:             | 1# 351348280012566     |             |             |
| Hardware Version: | V1.0                   |             |             |
| Software Version: | X80.0-01-14.0-15.26.00 |             |             |
| Antenna Type:     | PIFA Antenna           |             |             |
| Frequency Bands:  | Band                   | Tx (MHz)    | Rx (MHz)    |
|                   | GSM850                 | 824 - 849   | 869 - 894   |
|                   | GSM1900                | 1850 - 1910 | 1930 - 1990 |
|                   | WCDMA Band II          | 1850 - 1910 | 1930 - 1990 |
|                   | WCDMA Band IV          | 1710 - 1755 | 2110 - 2155 |
|                   | WCDMA Band V           | 824 - 849   | 869 - 894   |
|                   | LTE Band 2             | 1850 - 1910 | 1930 - 1990 |
|                   | LTE Band 4             | 1710 - 1755 | 2110 - 2155 |
|                   | LTE Band 5             | 824 - 849   | 869 - 894   |
|                   | LTE Band 7             | 2500 - 2570 | 2620 - 2690 |
|                   | LTE Band 12            | 699 - 716   | 729 - 746   |
|                   | LTE Band 13            | 777 - 787   | 746 - 756   |
|                   | LTE Band 14            | 704 - 716   | 734 - 746   |
|                   | LTE Band 25            | 1850 - 1915 | 1930 - 1995 |
|                   | LTE Band 26            | 814 - 849   | 859 - 894   |
|                   | LTE Band 30            | 2305 - 2315 | 2350 - 2360 |
|                   | LTE Band 38            | 2570 - 2620 | 2570 - 2620 |
|                   | LTE Band 41            | 2496 - 2690 | 2496 - 2690 |
|                   | LTE Band 42            | 3400 - 3600 | 3400 - 3600 |
|                   | LTE Band 48            | 3550 - 3700 | 3550 - 3700 |
|                   | LTE Band 66            | 1710 - 1780 | 2110 - 2200 |
|                   | LTE Band 71            | 663 - 698   | 617 - 652   |
|                   | Wi-Fi 2.4G             | 2402~2462   | 2402~2462   |
|                   | Wi-Fi 5G               | 5150~5250   | 5150~5250   |
|                   |                        | 5250~5350   | 5250~5350   |
|                   |                        | 5470~5725   | 5470~5725   |
|                   |                        | 5725~5850   | 5725~5850   |
|                   | Wi-Fi 6E               | 5925 - 6425 | 5925 - 6425 |

## 4.2 Air interfaces and Operation Mode.

| Air Interface                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Type | ANSI C63.19 Tested | Simultaneous Transmitter | Name of Voice Service | Power Reduction |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------|--------------------------|-----------------------|-----------------|
| GSM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | VO   | Yes                | BT, WLAN                 | CMRS Voice            | NO              |
| EDGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | VD   | Yes                |                          | Google Duo*           | NO              |
| WCDMA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | VO   | Yes                |                          | CMRS Voice            | NO              |
| LTE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | VD   | Yes                |                          | VoLTE<br>Google Duo*  | NO              |
| WLAN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | VD   | Yes                | WWAN                     |                       | NO              |
| Transport Type:<br>VO: Legacy Cellular Voice Service<br>DT: Digital Transport (no voice)<br>VD: IP Voice Service over Digital Transport                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                    |                          |                       |                 |
| Note:<br>a) *For protocols not listed in Table 6.1 of ANSI C63.19, the average speech level of -20 dBm0 should be used.<br>b) Per KDB 285076 D05, Wavier DA 23-914 only requires conversational gain compliance for CMRS narrowband and CMRS wideband voice codecs as started below. All other codecs either part of 3GPP set such as full-band and super-wideband codecs or OTT codecs are to be documented in the test report but not required to comply with the ANSI/TIA 5050 Volume Control Standard<br>c) The device has similar frequency in some LTE bands: LTE B2/25, LTE B4/66, LTE B5/26, LTE B12/17 since the supported frequency spans for the narrower LTE bands are completely cover by the wider LTE bands, therefore, only wider LTE bands were required to be tested for hearing-aid compliance.<br>d) The test channel is middle channel of each operation band. |      |                    |                          |                       |                 |

### EUT support Codec for Volume control test

| Air interface | Audio Codec Evaluated       |
|---------------|-----------------------------|
| GSM           | HR V1, FR V1, FR V2         |
| WCDMA         | AMR-NB,AMR-WB               |
| LTE           | AMR-NB,AMR-WB,EVS-NB,EVS-WB |
| WLAN          | AMR-NB,AMR-WB,EVS-NB,EVS-WB |

| Codec /Birate |           |           |          |          |          |
|---------------|-----------|-----------|----------|----------|----------|
| NB AMR        | WB AMR    |           | EVS NB   | EVS WB   |          |
| 4.75 Kbps     | 6.60Kbps  | 18.25Kbps | 5.9Kbps  | 5.9 Kbps | 24.4Kbps |
| 5.15Kbps      | 8.85Kbps  | 19.85Kbps | 7.2Kbps  | 7.2Kbps  | 32Kbps   |
| 5.90Kbps      | 12.65Kbps | 23.05Kbps | 8.0Kbps  | 8.0Kbps  | 48Kbps   |
| 6.60Kbps      | 14.25Kbps | 23.85Kbps | 9.6Kbps  | 9.6Kbps  | 64Kbps   |
| 7.40 Kbps     | 15.85Kbps |           | 13.2Kbps | 13.2Kbps | 96Kbps   |
| 7.95Kbps      |           |           | 16.4Kbps | 16.4Kbps | 128Kbps  |
| 10.20Kbps     |           |           | 24.4Kbps |          |          |
| 12.20Kbps     |           |           |          |          |          |

## 4.3 Test Environment

|                      |                   |
|----------------------|-------------------|
| Temperature          | Relative humidity |
| Relative humidity    | 54%               |
| Atmospheric pressure | 101.7kPa          |
| Background Noise     | 15dB              |

#### 4.4 Measurement Uncertainty

For ANSI/TIA-5050 testing, the EUT was linked and controlled by base station emulator. Communication between the EUT and the emulator was established by coaxial connection. The EUT was set from the emulator to radiate maximum output power during testing. Also EUT was set to backlight off during testing.

| Test Item                      | Uncertainty |
|--------------------------------|-------------|
| Receiving volume control       | 1.7dB       |
| Receiving distortion and noise | 1.7dB       |
| Receiving frequency response   | 1.7dB       |

Note:

- All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor  $k=2$ .
- Depends on the microphone calibration. The value is valid if calibration is carried out with recommended pistonphone/calibrator in the HMS II.3 manual.
- Time and frequency accuracies of labCORE determined by the internal clock accuracy. The time and frequency resolution and accuracy may change due to analysis of the digital signals in ACQUA or if an external clock is applied.

#### 4.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd. Suzhou Branch

No. 10, Weiye Road, Kunshan Development Zone, Suzhou, Jiangsu, China

No tests were sub-contracted.

Note:

- SGS is not responsible for wrong test results due to incorrect information (e.g., max. internal working frequency, antenna gain, cable loss, etc) is provided by the applicant. (If applicable).
- SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (If applicable).
- Sample(s) provided by customer.

#### 4.6 Test Facility

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

##### • A2LA

SGS-CSTC Standards Technical Services Co., Ltd. Suzhou Branch is accredited by the American Association for Laboratory Accreditation (A2LA). Certificate No. 6706.01.

##### • FCC

SGS-CSTC Standards Technical Services Co., Ltd. Suzhou Branch has been recognized by FCC as an accredited testing laboratory. Designation Number: CN1387.

##### • ISED

SGS-CSTC Standards Technical Services Co., Ltd. Suzhou Branch has been recognized by ISED as an accredited testing laboratory. Company Number: 32368

## 5 Equipment list

| Equipment                    | Model       | Equipment No. | Cal Data   | Cal Due Data |
|------------------------------|-------------|---------------|------------|--------------|
| Microphone                   | 46AE        | KSES307108    | 2024-06-13 | 2025-06-14   |
| Sound calibrator             | GRAS 42AG   | KSES304302a   | 2024-06-13 | 2025-06-14   |
| HEAD Measurement System      | HMS II.3-LN | KSES330101    | /          | /            |
| Multi-channel audio Analyzer | Labcore     | KSES304303    | 2024-06-13 | 2025-06-14   |
| Radio communication tester   | CMW 500     | SUEM100806    | 2024-02-02 | 2025-02-03   |
| Acoustic Chamber             | /           | KSES330801    | 2023-02-05 | 2025-02-06   |

## 6 Volume Control Requirement

### Conversational Gain

- Per KDB 285076 D05, with a mounting force of 8N, the DUT shall have at least one volume control setting that will produce a conversational gain of  $\geq 6$ dB.
- Per KDB 285076 D05, with a mounting force of 2N, the DUT shall have at least one volume control setting that will produce a conversational gain of  $\geq 6$ dB.
- Calculate the Conversational Gain by subtracting 70 from the measures SPL.  
[Conversational Gain = (Measured SPL Level-70dsSPL)]

### Receive Distortion and Noise Performance:

With a mounting force of 8N and 2N, the ratio of the stimulus signal power to the 100Hz to 8000Hz total A-weighted distortion and noise power shall  $\geq 20$ dB when tested over the range of 1/3 octave band center frequencies:

- Narrowband transmission mode: Each 1/3 octave band center frequency from 400Hz to 3150Hz.
- Wideband transmission mode: Each 1/3 octave band center frequency from 250Hz to 5000Hz.
- Per K 285076 D05, choose one narrowband and one wideband for all voice services, bands of operation and air interfaces over which it operates using one codec bit rate of the applicant's choosing to meet Receive Distortion and Noise Performance requirement.

### Receive Acoustic Frequency Response Performance:

- For the volume control settings determined in ANSI/TIA-5050 section 5.1.1 with a mounting force of 8N and 2N, the receive frequency response shall be measured at the DRP in 1/12 octave bands. After translation to the FF, it shall fall between the applicable upper and lower limits. The exact limit values at any 1/12 octave band center frequency falling between two consecutive points specified in the table may be calculated using the formula given in Eq 2 below:

$$X_f = X_1 + (X_2 - X_1) * \left( \frac{\log_{10} f - \log_{10} f_1}{\log_{10} f_2 - \log_{10} f_1} \right) \quad \text{Eq 2}$$

Where

$X_f$  = limit value at frequency  $f$

$X_1$  = limit value at frequency  $f_1$  as given in table

$X_2$  = limit value at frequency  $f_2$  as given in table

- For Narrowband: The 1/12 octave band frequency response after translation to the FF shall fall between the upper and lower limits (Arbitrary level) given the Table 1.
- For wideband: The 1/12 octave band frequency response after translation to the FF shall fall between the upper and lower limits (Arbitrary level) given the Table 2.

Table 1 – Narrowband Receive Frequency Response Limits

| Lower Limit Frequency (Hz) | Lower Limit (dB) | Upper Limit Frequency (Hz) | Upper Limit (dB) |
|----------------------------|------------------|----------------------------|------------------|
| 300                        | -6               | 100                        | +6               |
| 3400                       | -6               | 4000                       | +6               |

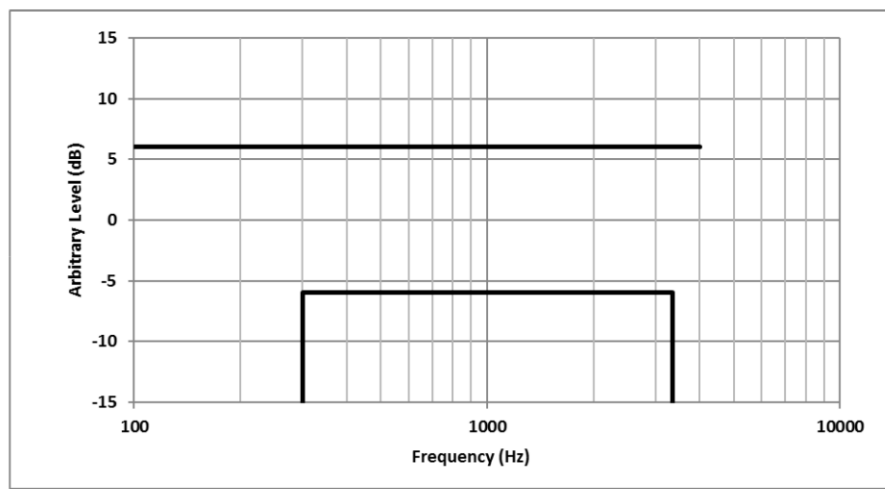


Figure 2 – Narrowband Receive Frequency Response Limits

Table 2 – Wideband Receive Frequency Response Limits

| Lower Limit Frequency (Hz) | Lower Limit (dB) | Upper Limit Frequency (Hz) | Upper Limit (dB) |
|----------------------------|------------------|----------------------------|------------------|
| 200                        | -10              | 100                        | +6               |
| 300                        | -6               | 1000                       | +6               |
| 5000                       | -6               | 2000                       | +8               |
| 6300                       | -12              | 8000                       | +8               |

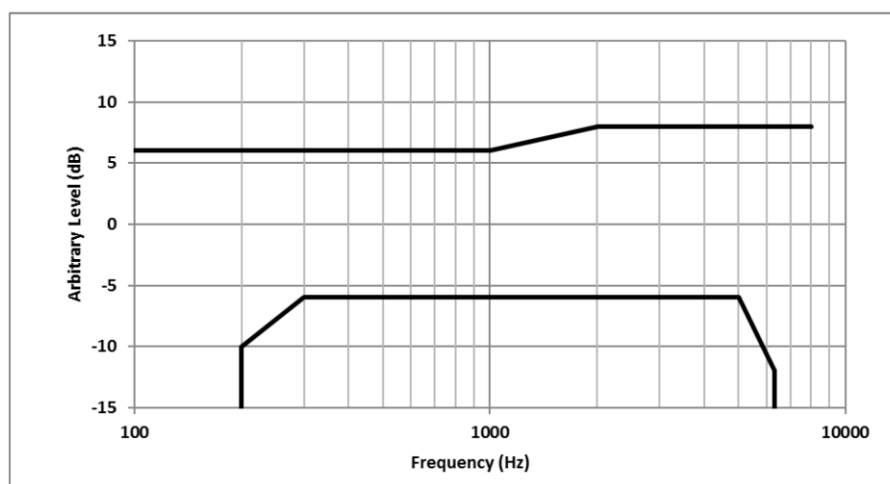


Figure 3 – Wideband Receive Frequency Response Limits

## 7 Measurement Procedure

According to ANSI /TIA-5050, the test procedure for wireless communications device is as below.

### Conversational Gain

- a) Configure the DUT with a mounting force of 8N and test equipment as shown in section 4 in an active call state with the applicable codec for the transmission mode under test.
- b) Set the DUT volume control to the maximum setting.
- c) If the DUT has an adjustable tone control feature, a tone control setting that meets the frequency response requirements in ANSI/TIA-5050 section 5.3.1 shall be used.
- d) The ACQUA system is apply the real speech test signal at a level of -20dBm0 at the RETP and measure the acoustic output at the Drum Reference Point (DRP) over one complete sequence of the test signal.
- e) Translate the measurement made at DRP to Free Filed (FF) using the translation data in ANSI/TIA-5050 AnnexB.
- f) Over the applicable frequency band, determine the ASL in SPL for the resulting sound pressure level in accordance with Method B of ITU-T Recommendation P.56,  
Narrowband 100Hz through 4000 Hz  
Wideband 100Hz through 7720 Hz  
Calculate the Conversational Gain by subtracting 70 from the measured dBSPL.  
[Conversational Gain = (Measured dBSPL Level – 7dBSPL) dB]
- g) Measure output distortion per ANSI/TIA-5050 clause 5.2. If a distortion failure occurs at the maximum volume control setting. reduce the volume control setting and repeat the measurement to determine if a setting can be found for which the conversational gain requirement is met without a distorton failure.
- h) Repeat steps 2-8 with a mounting force of 2N.

### Receive Distortion and Noise Performance:

- a) Configure the DUT with a mounting force of 8N and test equipment as shown in section in an active call state with the applicable codec for the transmission mode under test.
- b) Receive distortion and noise is measured using the PN-SDNR procedure.
- c) To ensure DUT activation, apply the real speech test signal at a level of -20 dBm0 followed immediately by the initial 1/3 octave center frequency PN test signal based on the narrowband or wideband operating mode. Measure the acoustic output at the DRP over the complete sequence of the PN test signal.
- d) Translate the measurement made at DRP to the FF.
- e) Calculate the acoustic out unweighted test signal power of the stimulus measurement band.
- f) Calculate the notched A-weighting distortion and noise components.
- g) Calculate the ratio of signal power to the total A-weighted distortion and noise power ad follow:  

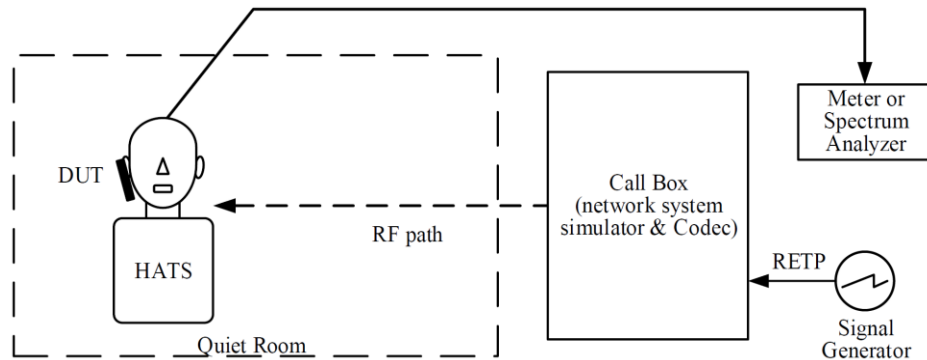
$$PN-SDNR (dB) = 20 * Log \left[ \frac{\text{measured stimulus amplitude}}{\text{measured distortion amplitude}} \right]$$
- h) Repeat for each of the remaining 1/3 octave center frequencies based on the narrowband or wideband operating mode.
- i) Repeat steps 2-8 with a mounting force of 2N.

- j) The measured value that the system equipment will automatically calculate or converts to define whether it meets the requirements of ANSI/TIA-5050.

**Receive Acoustic Frequency Response Performance:**

- a) Configure the DUT with a mounting force of 8N and test equipment as shown in Figure 1 in an active call state with the applicable codec for the transmission mode under test.
- b) If the DUT has an adjustable tone control feature the initial measurement is to be performed with the default tone control setting.
- c) Apply the real speech test signal with a level of -20 dBm0 at the RETP.
- d) Capture the frequency spectrum at the DRP of the HATS using real-time analysis with 1/12 octave bands over the frequency range from 100 Hz to 4000 Hz for narrowband measurements, or over the frequency range from 100 Hz to 8000 Hz for wideband measurements, averaged over the entire duration of the test signal.
- e) Transform the DRP frequency spectrum measurement to the FF.
- f) Divide the 1/12 octave measurement data by the 1/12 octave frequency spectrum of the test signal at the RETP and present the measurement in terms of (Pa/V).
- g) Apply the applicable frequency response limits to determine compliance.
- h) If the default tone control setting does not meet the requirement, repeat the above steps for other tone control settings to determine a tone control setting that meets the requirements.
- i) Repeat with a mounting force of 2N.
- j) The receive acoustic frequency response performance was performed at max tone control setting.

## 8 System Description



Above is the measurement set-up diagram, and the sequence of the measurement is Volume Control testing procedure over a wireless communication device:

- In order to satisfy the quiet room condition below 40 dBA background noise according to TIA-5050 standard, HATS and DUT were placed in Acoustic Chamber and the noise level was checked using Sound Level Meter 46AE.
- labCORE equipment is used for signal generator and meter. This equipment directly provided operating voltage for HATS's microphone and -20 dBm0 sound source to Call Box RETP Point.
- CMW500 Call box was used for GSM, WCDMA, LTE and WIFI call tests, where the audio input level was set to 1.572 V so that the signal source level supplied from labCORE to RETP matched -20 dBm0. When testing NR calls using CMX500 Call box.
- Handset Position, in all tests, handset was placed at the standard test position of IEEE std 269.

## **9 Test Result**

Refer to Appendix A - Volume Control Test Data and Plots.

## **10 Test Setup Photo**



## **11 EUT Constructional Details (EUT Photos)**

Refer to Appendix - Photographs of EUT Constructional Details for SUCR2406000201AT.

--- End of the Report ---