Element
7185 Oakland Mills Road, Columbia, MD 21046 USA
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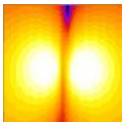


# HEARING AID COMPATIBILITY

**Applicant Name:**
Samsung Electronics Co., Ltd.
129, Samsung-ro, Maetan dong,
Yeongtong-gu, Suwon-si
Gyeonggi-do 16677, Korea

**Date of Testing:**
05/09/2025 – 05/15/2025
**Test Site/Location:**
Element Washington DC LLC,
Columbia, MD, USA
**Test Report Serial No.:**
1M2504220043-03.A3L
**Date of Issue:**
05/19/2025

| | |
|---|---|
| **FCC ID:** | **A3LSMF966U** |
| **APPLICANT:** | **SAMSUNG ELECTRONICS CO., LTD.** |

| | |
|---|---|
| **Scope of Test:** | Volume Control Testing |
| **Application Type:** | Class II Permissive Change |
| **FCC Rule Part(s):** | CFR §20.19(b) |
| **HAC Standard:** | ANSI C63.19-2019<br>ANSI/TIA-5050-2018<br>285076 D01 HAC Guidance v06<br>285076 D04 Volume Control v01 |
| **DUT Type:** | Portable Handset |
| **Model:** | SM-F966U |
| **Additional Model(s):** | SM-F966U1 |
| **Test Device Serial No.:** | *Sample* [S/N: 1755M] |
| **Class II Permissive Change(s):** | *See FCC Change Document* |

| | |
|---|---|
| **HAC Compliance:** | **PASS** |

This report only pertains to antenna G of this wireless portable device. Antenna G includes LTE Bands 66/4/25/2/30/7/38/41(PC3), and NR bands n70/66/25/2/30/7/41(PC2) modes. This wireless portable device has been shown to be hearing-aid compatible as specified in ANSI/IEEE Std. C63.19-2019 and has been tested in accordance with the specified measurement procedures. Test results reported herein relate only to the item(s) tested. Hearing-Aid Compatibility is based on the assumption that all production units will be designed electrically identical to the device tested in this report. North American Bands only.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

RI Ortanez
Executive Vice President

ACCREDITED
CERT #2041.01

# TABLE OF CONTENTS

# 1. INTRODUCTION

On July 10th, 2003, the Federal Communications Commission (FCC) adopted new rules requiring wireless manufacturers and service providers to provide digital wireless phones that are compatible with hearing aids. The FCC has modified the exemption for wireless phones under the Hearing Aid Compatibility Act of 1998 (HAC Act) in WT Docket 01-309 RM-8658[1] to extend the benefits of wireless telecommunications to individuals with hearing disabilities. These benefits encompass business, social and emergency communications, which increase the value of the wireless network for everyone. An estimated more than 10% of the population in the United States show signs of hearing impairment and of that percentage, almost 80% use hearing aids. Approximately 500 million people worldwide and 30 million people in the United States suffer from hearing loss.

**Ambient Conditions**

- Ambient temperature: 23 °C ± 5 °C
- Relative humidity (RH): 0% < RH < 80%
- Baseband magnetic ambient noise: >10 dB below the measurement level, where applicable

**Compatibility Tests Involved:**

The standard calls for wireless communications devices to be measured for:

- RF Electric-field emissions
- T-coil mode, magnetic-signal strength in the audio band
- T-coil mode, magnetic-signal frequency response through the audio band
- T-coil mode, magnetic-signal and noise articulation index
- Volume Control, receive conversational gain performance
- Volume Control, receive distortion and noise performance
- Volume Control, receive acoustic frequency response performance

The hearing aid must be measured for:

- RF immunity in microphone mode
- RF immunity in T-coil mode

In the following tests and results, this report includes the evaluation for a wireless communications device.

**Figure 1-1 Hearing Aid *in-vitu***

[1] FCC Rule & Order, WT Docket 01-309 RM-8658

# 2. DUT DESCRIPTION

| | |
|---|---|
| FCC ID: | A3LSMF966U |
| Applicant: | Samsung Electronics Co., Ltd.<br>129, Samsung-ro, Maetan dong,<br>Yeongtong-gu, Suwon-si<br>Gyeonggi-do 16677, Korea |
| Model: | SM-F966U |
| Additional Model(s): | SM-F966U1 |
| Serial Number: | 1755M |
| HW Version: | REV1.0 |
| SW Version: | F966U.001 |
| Antenna: | Internal Antenna |
| DUT Type: | Portable Handset |

## I. Band Selection

This device supports LTE/NR capabilities with overlapping transmission frequency ranges. When the supported frequency range of a band falls completely within a band with a larger transmission frequency range, both bands have the same target power (or the band with the larger transmission frequency range has a higher target power), and both bands share the same transmission path and signal characteristics, hearing-aid compatibility compliance was only assessed for the band with the larger transmission frequency range.

## II. Device Configuration

Please note the two device configurations evaluated with the DUT are referred to as ‘FOLDER – OPEN’ for the unfolded configuration and ‘FOLDER - CLOSED’ for the folded configuration of the device. ‘FOLDER - Closed’ configuration is considered by the manufacturer to be the default usage scenario of the device for held-to-ear calling. There is only one earpiece located on the front side of the device with the smaller LED screen. The side of the device with the larger LED screen in unfolded configuration does not have an earpiece and is not evaluated as a held-to-ear configuration. The ‘FOLDER - CLOSED’ configuration evaluates the device as a typical bar phone while the ‘FOLDER - OPEN’ configuration evaluates the device in the larger unfolded configuration with earpiece held to ear. FOLDER-OPEN was additionally tested to ensure acoustic consistency with the fully tested FOLDER-CLOSED configuration.

# Table 2-1
# HAC Air Interfaces

| Air-Interface | Band (MHz) | Type Transport | HAC Tested | Simultaneous But Not Tested | Name(s) of Voice Service(s) | Supported Codec(s) | Volume Control Evaluated | Test Category | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Conversational Gain | Distortion | Frequency Response |
| GSM | 850 | VO | Yes[1,7] | Yes: WIFI or BT | CMRS Voice | EFR | Yes | FR V1, FR V2, HR V1 | N/A | |
| | 1900 | | | | | | | | | |
| | GPRS/EDGE | VD | No | Yes: WIFI or BT | Google Meet | OPUS[5] | No | N/A | | |
| UMTS | 850 | VD | Yes[1,7] | Yes: WIFI or BT | CMRS Voice | AMR | Yes | NB AMR, WB AMR | N/A | |
| | 1700 | | | | | | | | | |
| | 1900 | | | | | | | | | |
| | HSPA | VD | No | Yes: WIFI or BT | Google Meet | OPUS[5] | No | N/A | | |
| LTE (FDD) | 680 (B71) | VD | Yes[1,2,7] | Yes: NR, WIFI or BT | VoLTE, Google Meet | VoLTE: AMR, EVS Google Meet: OPUS[5] | Yes | NB AMR, WB AMR, NB EVS, WB EVS | NB EVS 24.4KBPS, WB EVS 128.0KBPS | NB EVS 24.4KBPS, WB EVS 128.0KBPS |
| | 700 (B12) | | | | | | | | | |
| | 780 (B13) | | | | | | | | | |
| | 790 (B14) | | | | | | | | | |
| | 850 (B5) | | | | | | | | | |
| | 850 (B26) | | | | | | | | | |
| | 1700 (B4) | | Yes[1,2] | | | | | | | |
| | 1700 (B66) | | | | | | | | | |
| | 1900 (B2) | | | | | | | | | |
| | 1900 (B25) | | | | | | | | | |
| | 2300 (B30) | | | | | | | | | |
| | 2500 (B7) | | | | | | | | | |
| LTE (TDD) | 2600 (B41) | VD | Yes[1,2] | Yes: NR, WIFI or BT | VoLTE, Google Meet | VoLTE: AMR, EVS Google Meet: OPUS[5] | Yes | NB AMR, WB AMR, NB EVS, WB EVS | NB EVS 24.4KBPS, WB EVS 128.0KBPS | NB EVS 24.4KBPS, WB EVS 128.0KBPS |
| | 2600 (B38) | | | | | | | | | |
| | 3600 (B48) | | Yes[1,2,7] | | | | | | | |
| LTE NTN | 1640 (B255) | DT | No | N/A | | | | | | |
| NR (FDD) | 680 (n71) | VD | Yes[1,2,7] | Yes: LTE, WIFI or BT | VoNR, Google Meet | VoNR: AMR, EVS Google Meet: OPUS[5] | Yes | NB AMR, WB AMR, NB EVS, WB EVS | NB EVS 24.4KBPS, WB EVS 128.0KBPS | NB EVS 24.4KBPS, WB EVS 128.0KBPS |
| | 700 (n12) | | | | | | | | | |
| | 790 (n14) | | | | | | | | | |
| | 850 (n26) | | | | | | | | | |
| | 850 (n5) | | | | | | | | | |
| | 1700 (n70) | | Yes[1,2] | | | | | | | |
| | 1700 (n66) | | | | | | | | | |
| | 1900 (n2) | | | | | | | | | |
| | 1900 (n25) | | | | | | | | | |
| | 2300 (n30) | | | | | | | | | |
| | 2500 (n7) | | | | | | | | | |
| NR (TDD) | 2600 (n41) | VD | Yes[1,2] | Yes: LTE, WIFI or BT | VoNR, Google Meet | VoNR: AMR, EVS Google Meet: OPUS[5] | Yes | NB AMR, WB AMR, NB EVS, WB EVS | NB EVS 24.4KBPS, WB EVS 128.0KBPS | NB EVS 24.4KBPS, WB EVS 128.0KBPS |
| | 2600 (n38) | | | | | | | | | |
| | 3500 (n77, DoD) | | Yes[1,2,7] | | | | | | | |
| | 3500 (n78, DoD) | | | | | | | | | |
| | 3600 (n78) | | | | | | | | | |
| | 3600 (n48) | | | | | | | | | |
| | 3700 (n77) | | | | | | | | | |
| | 3700 (n78) | | | | | | | | | |
| | 24500 (n258) | | No[6] | Yes: LTE, WIFI or BT | VoNR, Google Meet | VoNR: AMR, EVS Google Meet: OPUS[5] | No | N/A | | |
| | 28000 (n261) | | | | | | | | | |
| | 39000 (n260) | | | | | | | | | |
| WIFI | 2450 | VD | Yes[1,2,7] | Yes: GSM, UMTS, LTE, or NR | VoWIFI, Google Meet | VoWIFI: AMR, EVS Google Meet: OPUS[5] | Yes | NB AMR, WB AMR, NB EVS, WB EVS | NB EVS 24.4KBPS, WB EVS 128.0KBPS | NB EVS 24.4KBPS, WB EVS 128.0KBPS |
| | 5200 (U-NII 1) | | | | | | | | | |
| | 5300 (U-NII 2A) | | | | | | | | | |
| | 5500 (U-NII 2C) | | | | | | | | | |
| | 5800 (U-NII 3) | | | | | | | | | |
| | 5900 (U-NII 4) | | | | | | | | | |
| | 6175 (U-NII 5) | | Yes[1,2,3,7] | | | | | | | |
| | 6475 (U-NII 6) | | No[4] | Yes: GSM, UMTS, LTE, or NR | VoWIFI, Google Meet | VoWIFI: AMR, EVS Google Meet: OPUS[5] | No | N/A | | |
| | 6700 (U-NII 7) | | | | | | | | | |
| | 7000 (U-NII 8) | | | | | | | | | |
| BT | 2450 | DT | No | Yes: GSM, UMTS, LTE, or NR | N/A | | | | | |

**Type Transport:**
VO = Voice Only
DT = Digital Data - Not intended for Voice Services
VD = CMRS and/or IP Voice over Data Transport

**Notes:**
1. According to FCC guidance and waiver DA 23-914, all CMRS codecs supported by the model are tested for Conversational Gain.
2. According to FCC guidance and waiver DA 23-914, manufacturer has chosen NB EVS 24.4KBPS and WB EVS 128KBPS audio codecs and bitrate supported on this device for Frequency Response and Distortion evaluation.
3. WIFI U-NII band 5 was evaluated for operations which are entirely below 6 GHz. Operations partially or entirely above 6 GHz were not evaluated due to equipment limitations and being outside of the current scope of ANSI C63.19 and FCC HAC regulations.
4. WIFI U-NII bands 6 through 8 were not evaluated due to being outside the scope of ANSI C63.19 and FCC HAC regulations.
5. According to FCC guidance, AMR and EVS codecs were chosen for Volume Control evaluation. Other supported codecs were not evaluated.
6. n258, n260, and n261 are currently outside the scope of ANSI C63.19 and FCC HAC regulations therefore they were not evaluated.
7. This report only pertain to antenna G of this wireless portable device. Antenna G includes LTE Bands 66/4/25/2/30/7/38/41(PC3), and NR band n70/66/25/2/30/7/41(PC2) modes. For full data, please refer to the Original Certification Test Report (Report S/N: 1M2502210015-33.A3L).

# 3. ANSI C63.19-2019 PERFORMANCE CATEGORIES

## I. Acoustic Coupling Requirements

According to ANSI C63.19-2019 §7, devices shall comply with ANSI/TIA-5050-2018 in order to comply with C63.19-2019. No additional requirements are imposed, and no special allowances are made regarding testing in compliance with ANSI/TIA-5050-2018.

## II. ANSI/TIA-5050-2018 Volume Control

All Volume Control requirements (i.e., Receive Conversational Gain, Receive Distortion and Noise, and Receive Frequency Response) shall be met for at least one volume control setting for narrowband as well as wideband (as applicable) per §5. All testing shall be performed with both a 2N mounting force and an 8N mounting force. The passing volume control setting may be different between narrowband and wideband tests as well as between 2N and 8N tests, but the setting may not change within a test in order to pass the separate performance criteria.

Note: The test data margins indicate a margin from the limit for compliance.

### 1. Receive Conversational Gain Performance

With a mounting force of 8N, the DUT shall have a Receive Conversational Gain of ≥18dB per §5.1.1, and with a mounting force of 2N, the DUT shall have a Receive Conversational Gain of ≥6dB per ANSI/TIA-5050-2018 §5.1.1.

### 2. Receive Distortion and Noise Performance

With a mounting force of 8N and 2N, the Pulsed Noise Signal-to-Distortion and Noise Ratio (PN-SDNR) of the DUT shall be ≥20dB when tested over the applicable 1/3 octave band center frequencies per ANSI/TIA-5050-2018 §5.2.1. For narrowband, the applicable 1/3 octave band center frequencies are from 400Hz to 3.15kHz; for wideband, the applicable 1/3 octave band center frequencies are from 250Hz to 5kHz.

### 3. Receive Acoustic Frequency Response Performance

With a mounting force of 8N and 2N, the Receive Acoustic Frequency Response, as measured at the DRP in 1/12 octave bands and after translation to the diffuse field or free field, shall fall between the applicable upper and lower limits per ANSI/TIA-5050-2018 §5.3.1. See below for narrowband limits (Table 3-1 and Figure 3-1) and wideband limits (Table 3-2 and Figure 3-2).

**Table 3-1**
**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 |

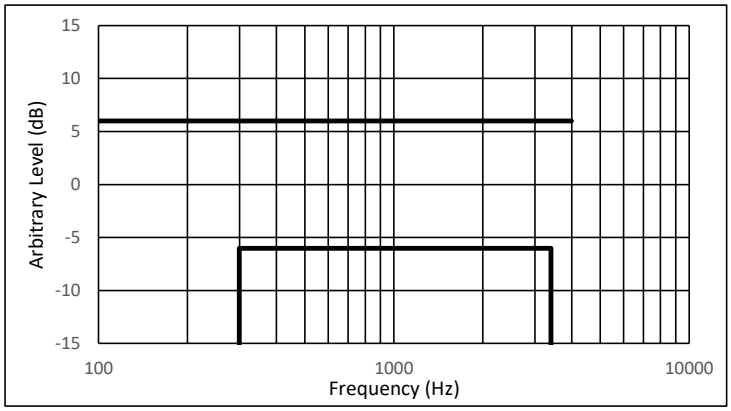



**Figure 3-1**
**Narrowband Receive Frequency Response Limits**

**Table 3-2**
**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 |
| 6000 | -12 | 8000 | +8 |

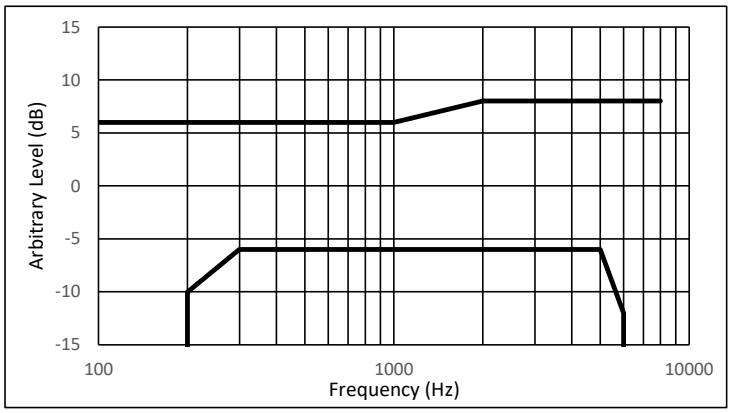



**Figure 3-2**
**Wideband Receive Frequency Response Limits**

# 4. METHOD OF MEASUREMENT

## I. Test Setup

The equipment was connected as shown in an RF-shielded chamber:

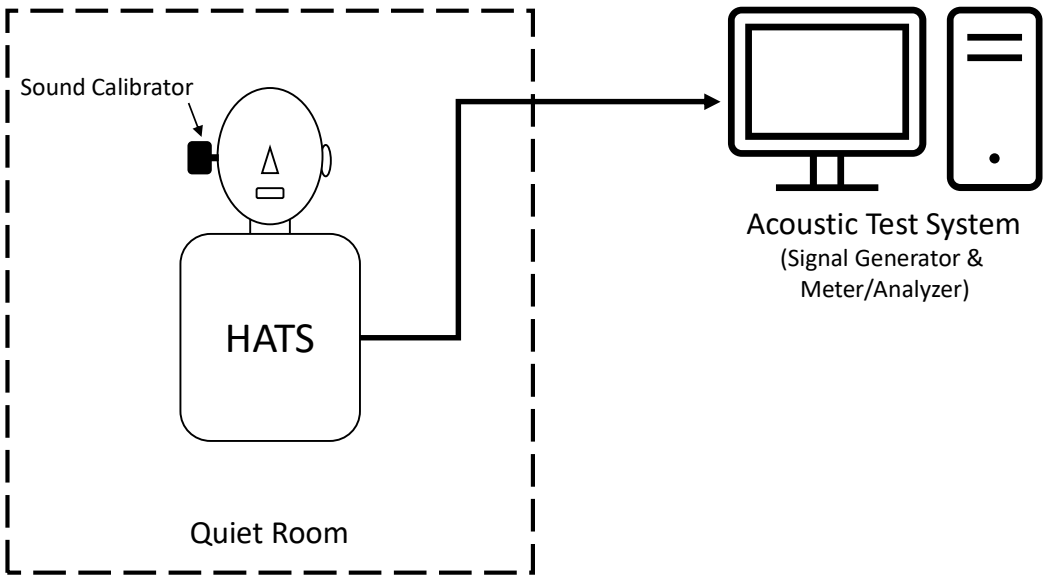



**Figure 4-1**
**Verification Setup with Sound Calibrator**

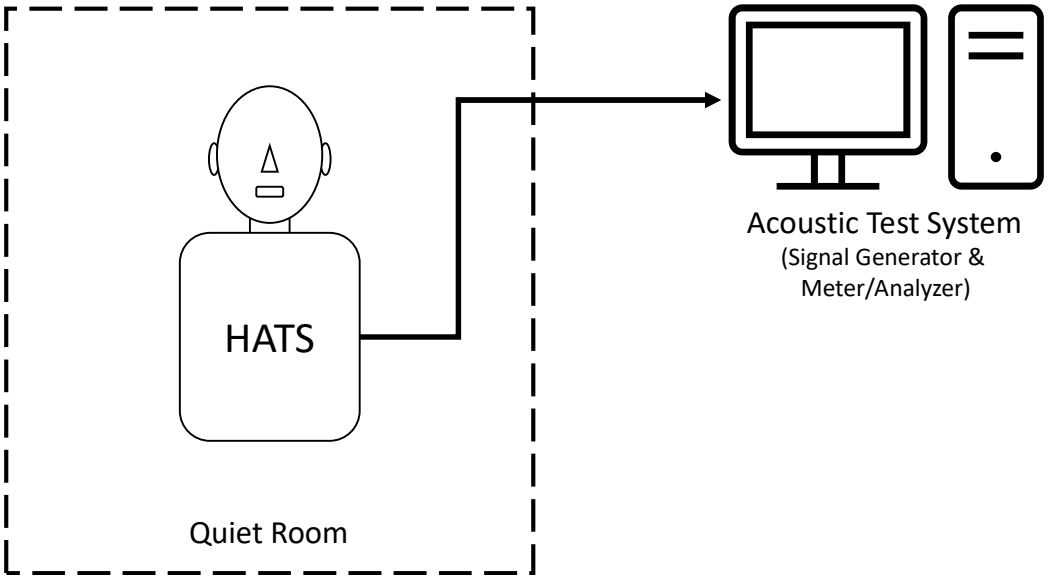



**Figure 4-2**
**Ambient Noise Verification Setup**

## II. Head and Torso Simulator

| | |
|---|---|
| Manufacturer: | Brüel & Kjær |
| Model: | Type 4128-D |
| Frequency Response: | Conforms to ITU-T Rec. P.58 up to 16 kHz |
| Ear Simulator: | ITU-T Rec. P.57 Type 3.3-based calibrated ear simulator complying with ITU-T Rec. P.57 |
| Ear Simulator Output: | 7-core, 3 m cable terminated with a Lemo® (1B) plug |
| Pressure-field Response: | ±1 dB from 5 Hz to 7 kHz<br>±3 dB from 3.15 Hz to 20 kHz |
| Typical Noise Level | 19 dBA at DRP |
| Pinna Simulator: | Compliant with ITU-T Rec. P.58 |
| Total Head and Torso Height: | 695mm |
| HATS Dimensions: | Main dimensions comply with the dimensional requirements of ITU-T Rec. P.58 |
| Handset Positioner: | Brüel & Kjær Type 4606 |
| Positioner Angles: | Variable positions; ∠A adjustable from +15° to +35°, ∠B adjustable from +30° to –10°, ∠C adjustable from +20° to –20°; 0.5° resolution |
| Applied Ear Force: | Mounting force can be adjusted from 0 to 18 N |

**Figure 4-3**
Heat and Torso Simulator
(with Handset Positioner)

## III. IEEE Std 269 Uncompressed Real Male Speech

| | |
|---|---|
| Manufacturer: | IEEE |
| Active Frequency Range: | 100 Hz – 8 kHz |
| Stimulus Type: | Multi-talker speech signal, four male speakers |
| Single Sample Duration: | 12 seconds |
| Activity Level: | 84% |

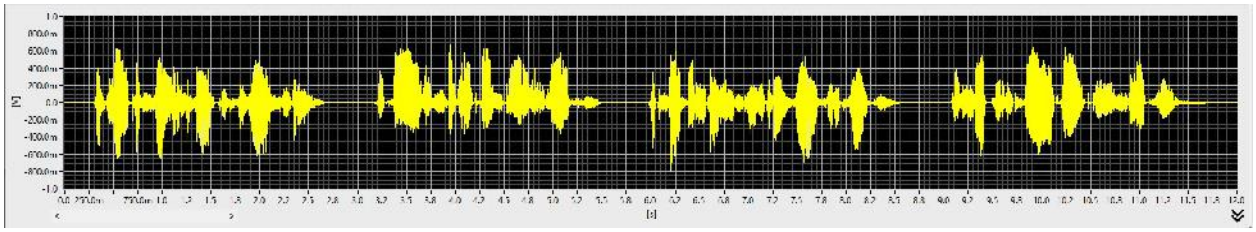


**Figure 4-4**
**Temporal Characteristic of full IEEE 269**

Volume Control Measurement Block Diagrams:

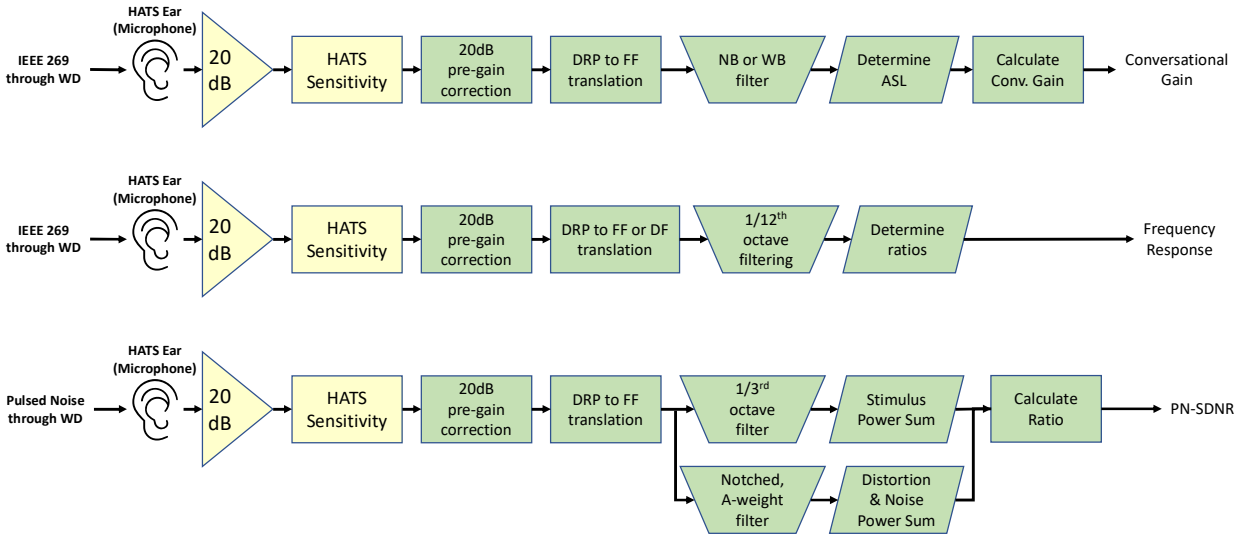



**Figure 4-5 Acoustic Measurement Processing Steps**

# IV. Test Procedure

1. Ambient Noise Check per ANSI/TIA-5050-2018 §3.1 (See Figure 4-2)
   a. Ambient noise was monitored using a Real-Time Analyzer between 100-10,000 Hz with 1/12 octave filtering.
   b. "A-weighting" was applied to the measurements per the definition of a "quiet room" in ANSI/TIA-5050-2018. Below is the verification of the system processing A-weighting between system input to output within 0.5 dB of the theoretical result:

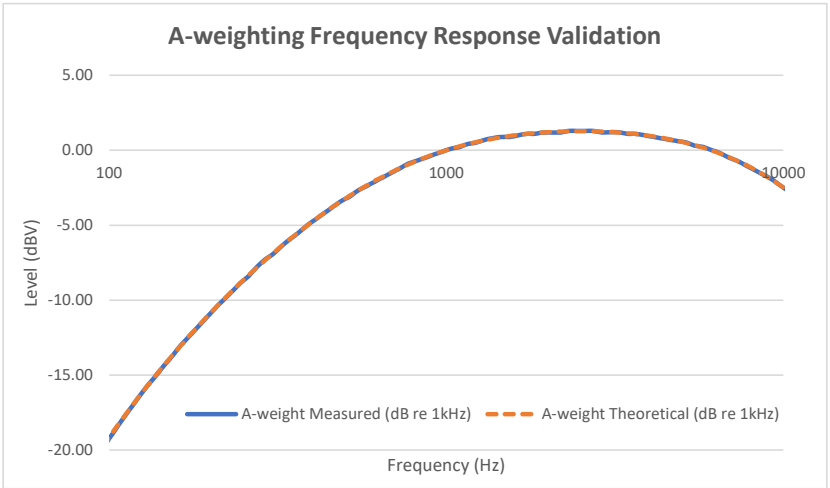



**Figure 4-6**
**A-weighting Frequency Response Validation**

**Table 4-1**
**A-weighting Frequency Response Validation**

| f (Hz) | A-weight Measured (dB re 1kHz) | A-weight Theoretical (dB re 1kHz) | Deviation (dB) | f (Hz) | A-weight Measured (dB re 1kHz) | A-weight Theoretical (dB re 1kHz) | Deviation (dB) |
|---|---|---|---|---|---|---|---|
| 97.2 | -19.63 | -19.54 | -0.09 | 1030 | 0.10 | 0.09 | 0.01 |
| 103 | -18.81 | -18.74 | -0.07 | 1090 | 0.20 | 0.25 | -0.05 |
| 109 | -18.01 | -17.97 | -0.04 | 1150 | 0.40 | 0.38 | 0.02 |
| 115 | -17.31 | -17.26 | -0.05 | 1220 | 0.50 | 0.52 | -0.02 |
| 122 | -16.51 | -16.50 | -0.01 | 1300 | 0.70 | 0.66 | 0.04 |
| 130 | -15.71 | -15.70 | -0.01 | 1370 | 0.80 | 0.76 | 0.04 |
| 137 | -15.11 | -15.06 | -0.05 | 1450 | 0.89 | 0.85 | 0.04 |
| 145 | -14.41 | -14.38 | -0.03 | 1540 | 0.89 | 0.94 | -0.05 |
| 154 | -13.71 | -13.68 | -0.03 | 1630 | 0.99 | 1.02 | -0.03 |
| 163 | -13.01 | -13.04 | 0.03 | 1730 | 1.09 | 1.08 | 0.01 |
| 173 | -12.40 | -12.38 | -0.02 | 1830 | 1.09 | 1.14 | -0.05 |
| 183 | -11.80 | -11.77 | -0.03 | 1940 | 1.19 | 1.18 | 0.01 |
| 194 | -11.20 | -11.16 | -0.04 | 2050 | 1.18 | 1.22 | -0.04 |
| 205 | -10.60 | -10.60 | 0.00 | 2180 | 1.19 | 1.24 | -0.05 |
| 218 | -10.00 | -9.98 | -0.02 | 2300 | 1.29 | 1.26 | 0.03 |
| 230 | -9.50 | -9.46 | -0.04 | 2440 | 1.29 | 1.27 | 0.02 |
| 244 | -8.90 | -8.90 | 0.00 | 2590 | 1.29 | 1.27 | 0.02 |
| 259 | -8.40 | -8.35 | -0.05 | 2740 | 1.29 | 1.26 | 0.03 |
| 274 | -7.80 | -7.84 | 0.04 | 2900 | 1.19 | 1.24 | -0.05 |
| 290 | -7.30 | -7.35 | 0.05 | 3070 | 1.20 | 1.22 | -0.02 |
| 307 | -6.90 | -6.86 | -0.04 | 3250 | 1.20 | 1.18 | 0.02 |
| 325 | -6.40 | -6.39 | -0.01 | 3450 | 1.10 | 1.13 | -0.03 |
| 345 | -5.90 | -5.90 | 0.00 | 3650 | 1.10 | 1.08 | 0.02 |
| 365 | -5.50 | -5.46 | -0.04 | 3870 | 1.00 | 1.01 | -0.01 |
| 387 | -5.00 | -5.02 | 0.02 | 4100 | 0.90 | 0.93 | -0.03 |
| 410 | -4.60 | -4.59 | -0.01 | 4340 | 0.80 | 0.84 | -0.04 |
| 434 | -4.20 | -4.19 | -0.01 | 4600 | 0.70 | 0.73 | -0.03 |
| 460 | -3.80 | -3.79 | -0.01 | 4870 | 0.61 | 0.61 | 0.00 |
| 487 | -3.40 | -3.42 | 0.02 | 5160 | 0.51 | 0.48 | 0.03 |
| 516 | -3.10 | -3.05 | -0.05 | 5460 | 0.31 | 0.33 | -0.02 |
| 546 | -2.70 | -2.71 | 0.01 | 5790 | 0.21 | 0.16 | 0.05 |
| 579 | -2.40 | -2.37 | -0.03 | 6130 | 0.01 | -0.02 | 0.03 |
| 613 | -2.10 | -2.05 | -0.05 | 6490 | -0.19 | -0.22 | 0.03 |
| 649 | -1.80 | -1.75 | -0.05 | 6880 | -0.49 | -0.45 | -0.04 |
| 688 | -1.50 | -1.47 | -0.03 | 7290 | -0.69 | -0.70 | 0.01 |
| 729 | -1.20 | -1.20 | 0.00 | 7720 | -0.99 | -0.97 | -0.02 |
| 772 | -0.90 | -0.94 | 0.04 | 8180 | -1.30 | -1.26 | -0.04 |
| 818 | -0.70 | -0.71 | 0.01 | 8660 | -1.59 | -1.58 | -0.01 |
| 866 | -0.50 | -0.49 | -0.01 | 9170 | -1.89 | -1.92 | 0.03 |
| 917 | -0.30 | -0.28 | -0.02 | 9720 | -2.29 | -2.30 | 0.01 |
| 972 | -0.10 | -0.09 | -0.01 | 10300 | -2.69 | -2.70 | 0.01 |

c. The ambient room noise is a power sum of the A-weighted spectrum from 100-10,000 Hz. To verify the power sum measurement, a power sum over the full band was measured and verified to track with the source level. Therefore, the setup in this step was used to verify the power sum post-processing for measurements. See below block diagram:

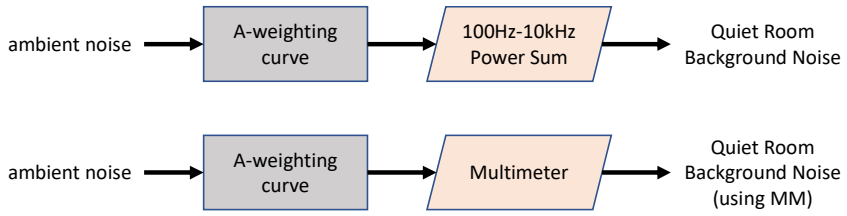



**Figure 4-7**
**Power Sum Validation Block Diagram**

The power summed output results for a known input were compared to the multi-meter results to verify any deviation in the post-processing implemented with the power-sum.

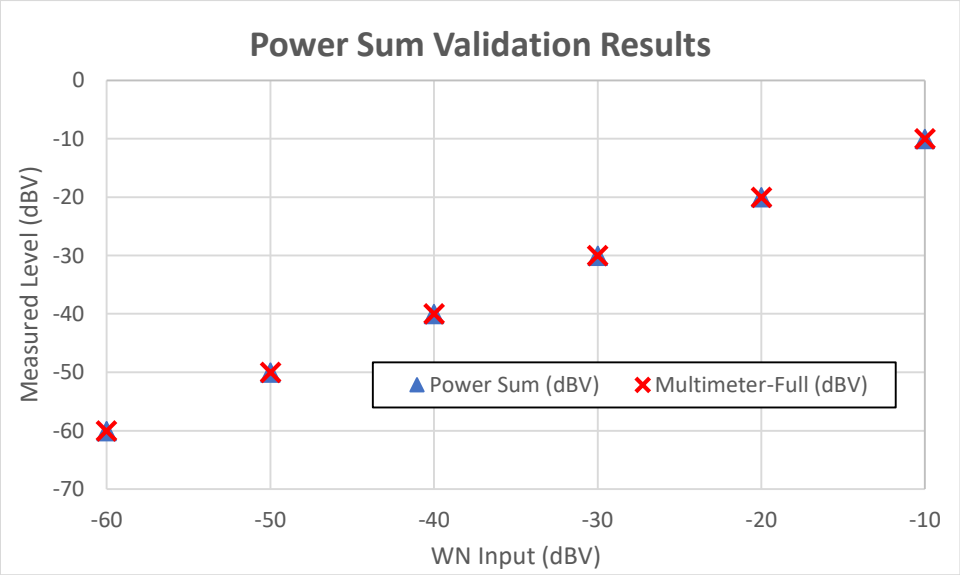



**Figure 4-8**
**Power Sum Validation Results**

**Table 4-2**
**Power Sum Validation Results**

| WN Input (dBV) | Power Sum (dBV) | Multimeter-Full (dBV) | Dev (dB) |
|---|---|---|---|
| -60 | -60.05 | -60.03 | 0.02 |
| -50 | -50.04 | -50.03 | 0.01 |
| -40 | -40.04 | -40.02 | 0.02 |
| -30 | -30.04 | -30.02 | 0.02 |
| -20 | -20.05 | -20.03 | 0.02 |
| -10 | -10.05 | -10.03 | 0.02 |

d. The maximum room noise inside the quiet room was recorded and verified to be less than or equal to 40dBA.

2. Measurement System Validation (See Figure 4-1)
   a. The measurement system including the HATS, pre-amplifier and acquisition system were validated as an entire system to ensure the reliability of test measurements.
   b. HATS Sensitivity Verification
   A pure tone of 1kHz was applied into the HATS ear (microphone) using a calibrated sound calibrator. The sound calibrator generates an expected sound pressure level of 97.1dBSPL at the HATS ear which was used to verify the measured signal from the HATS. This measured value was verified to be within ±0.2dB of the 97.1dBSPL expected value (see Page 32).

3. Measurement Test Setup
   a. Positioning DUT in HATS

i. According to ANSI/TIA-5050-2018 §4.2, a HATS which is ITU-T P.58 compliant and an ear simulator which is ITU-T P.57 type 3.3 compliant are used for Volume Control testing.
ii. Per ANSI/TIA-5050-2018 §4.3, the DUT is positioned on the HATS in the standard test position according to IEEE Std 269 or, alternatively, a recommended test position specified by the manufacturer. Manufacturer recommended positions must comply with the recommended test position requirements in IEEE Std 269 and, if used, are noted in this report.
iii. The DUT is mounted such that a certain force, in Newtons (N), is applied when the DUT is placed against the artificial pinna. ANSI/TIA-5050-2018 specifies a mounting force of either 2N or 8N, depending on the test. Mounting force is indicated for each test in this report.

b. Speech Signal Setup and Analysis
i. For testing in this report, the test signal is the uncompressed real male speech as published with IEEE Std 269 unless otherwise specified.
ii. The test signal is used with an Active Speech Level (ASL) of -20dBm0, and analysis is performed with 1/12 octave bands averaged over one complete sequence of the test signal unless otherwise specified.
iii. The acoustic listener reference point for testing is the Free Field (FF) for Receive Conversational Gain and PN-SDNR measurements. For Receive Frequency Response (FR) measurements, the acoustic listener reference point is either the Free Field (FF) or the Diffuse Field (DF); the chosen acoustic listener reference point for FR measurements in this report is indicated for each test.
iv. Per the Spring 2021 TCB Workshop, all supported audio voice codecs are tested for the DUT. For each codec, narrowband and wideband modes are tested if supported. For narrowband modes, a source coding bit-rate of 12.2 kbps, or the closest available setting, is used. For wideband modes, a source coding bit-rate of 12.65 kbps, or the closest available setting, is used.

c. DUT Radio Configuration
i. Each supported codec may be tested with any air interface which supports the codec being tested. Air interfaces used for testing in this report are noted with each test.

4. Measurement Data Analysis
a. Receive Conversational Gain
i. With the DUT at its maximum volume control setting and tone control set such that the DUT meets the FR requirements, the test signal is applied to the DUT, and the resulting acoustic output is measured at the Drum Reference Point (DRP). A lower volume setting may be used if needed to meet the PN-SDNR requirements.
ii. The appropriate post processing is applied according to the system processing chain shown in Figure 4-5, and the Receive Conversational Gain is determined.
iii. Receive Conversational Gain is tested with both 8N and 2N mounting forces.

b. PN-SDNR
i. The DUT is tested for Receive Distortion and Noise using PN-SDNR which is the ratio of the signal power to the full, A-weighted distortion and noise power of the DUT output (in dB).
ii. The pulsed noise stimulus signal is a combination of the real speech test signal followed by a series of pink noise pulses from a 1/3 octave band. A stimulus signal is generated for each 1/3 octave band centered within the applicable frequency range for either narrowband or wideband.
iii. Each stimulus signal is applied to the DUT, and the resulting acoustic output is measured at the DRP.

iv. The appropriate post-processing is applied according to the system-processing chain shown in Figure 4-5, and the PN-SDNR is determined by subtracting the full, A-weighted distortion and noise power, from the signal power. This process is repeated to determine the PN-SDNR for all applicable 1/3 octave band frequencies.
v. PN-SDNR is tested with both 8N and 2N mounting force and may be repeated at volume levels below maximum if needed to get passing results. Note that Receive Conversational Gain must still receive passing results while at the lower volume level if such a lower level is used for PN-SDNR compliance.

c. Receive Frequency Response
   i. Receive Frequency Response (FR) is measured with respect to the appropriate curves from either Figure 3-1, for narrowband modes, or Figure 3-2, for wideband modes. The measurement is taken over one full sequence of the test signal, although a delay was configured in the measurement process of the stimulus to ensure handset vocoder latency effects and echo cancellation devices (if any) were appropriately stabilized during measurements.
   ii. The appropriate post-processing is applied according to the system-processing chain shown in Figure 4-5, and the FR is determined. All 1/12 octave band center frequencies are plotted and aligned with respect to the applicable mask in a floating, or best fit, fashion.
   iii. FR is tested with both 8N and 2N mounting forces and may be repeated with tone control settings other than default if needed to get passing results. Note that Receive Conversational Gain must still receive passing results while using the non-default tone control settings if such non-default settings are used for FR compliance.

d. Speech Signal Setup to Base Station Simulator
   i. See Section 5 for more information regarding CMW500 audio level settings for Voice Over LTE (VoLTE) and Voice Over WIFI (VoWIFI) testing.
   ii. See Section 6 for more information regarding CMX500 audio level settings for Voice Over NR (VoNR).

e. WD Radio Configuration Selection
   i. The device was chosen to be tested in the default test configuration (LTE configuration information can be found in Section 5. NR configuration information can be found in Section 6).

## V. Test Setup

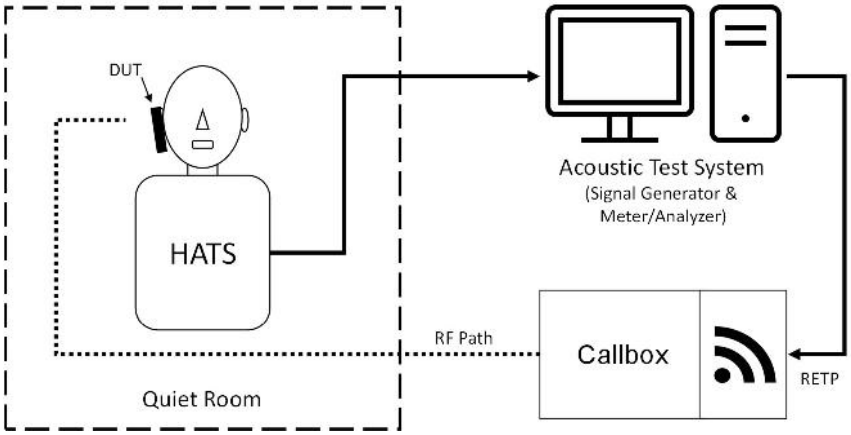



**Figure 4-9**
**Volume Control Test Setup**

Environmental conditions such as temperature and relative humidity are monitored to ensure there are no impacts on system specifications. Proper voltage and power line frequency conditions are maintained with three phase power sources. Environmental noise and reflections are monitored through system checks.

## VI. Deviation from ANSI/TIA-5050-2018 Test Procedure

Deviation from ANSI/TIA-5050-2018 Test Procedure to indicate guidance in FCC HAC waiver was followed.

## VII. Air Interface Technologies Tested

According to ANSI/TIA-5050-2018, any air interface which support voice capabilities over a managed CMRS or pre-installed OTT VoIP applications may be chosen for Volume Control testing. According to the Spring 2021 TCB Workshop, all voice codecs supported by the DUT must be tested for Volume Control. The air interfaces used during testing were chosen such that all voice codecs supported by the DUT were able to be tested. See Table 2-1 for more details regarding which modes were tested.

## VIII. Wireless Device Channels and Frequencies

### 1. 4G (LTE) Modes

The middle channel for every band was tested for Receive Conversational Gain to confirm that the band configuration for VoLTE over IMS does not substantially affect the results. The default band was additionally tested for Receive Frequency Response and Receive Distortion and Noise. More information on default LTE test configuration chosen for testing can be found in Section 5. See Tables 8-2 and 8-3 for full Volume Control evaluation.

### 2. 5G (NR) Modes

The middle channel for every band was tested for Receive Conversational Gain to confirm that the band configuration for VoNR over IMS does not substantially affect the results. The default band was additionally tested for Receive Frequency Response and Receive Distortion and Noise. More information on default NR test configuration chosen for testing can be found in Section 6. See Tables 8-4 and 8-5 for full Volume Control evaluation.

## IX. Test Flow

The flow diagram below was followed:

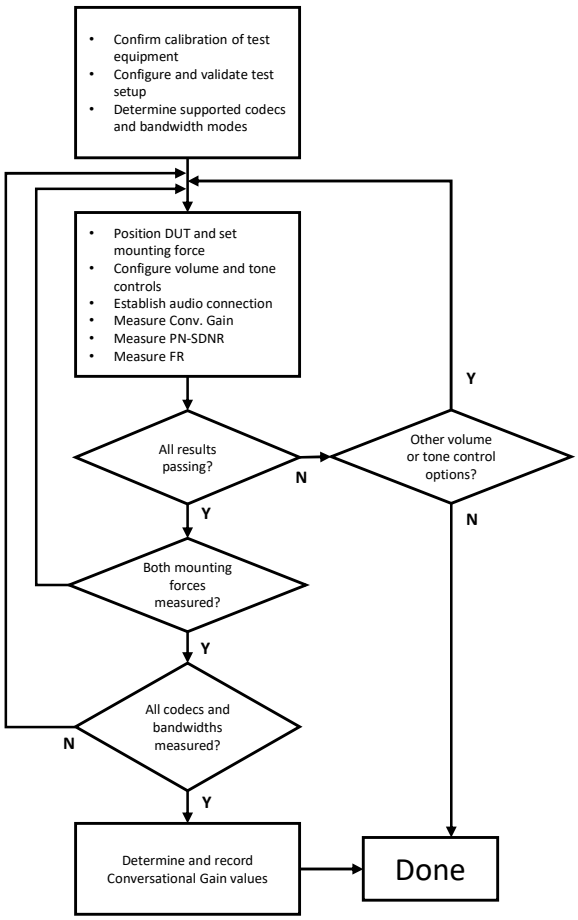



**Figure 4-10**
**C63.19 Volume Control Test Process**

# 5. VOLTE TEST SYSTEM SETUP AND DUT CONFIGURATION

## I. Test System Setup for VoLTE over IMS T-coil Testing

### 1. Equipment Setup

The general test setup used for VoLTE over IMS is shown below. The callbox used when performing VoLTE over IMS Volume Control measurements is a CMW500. The Data Application Unit (DAU) of the CMW500 was used to simulate the IP Multimedia Subsystem (IMS) server.

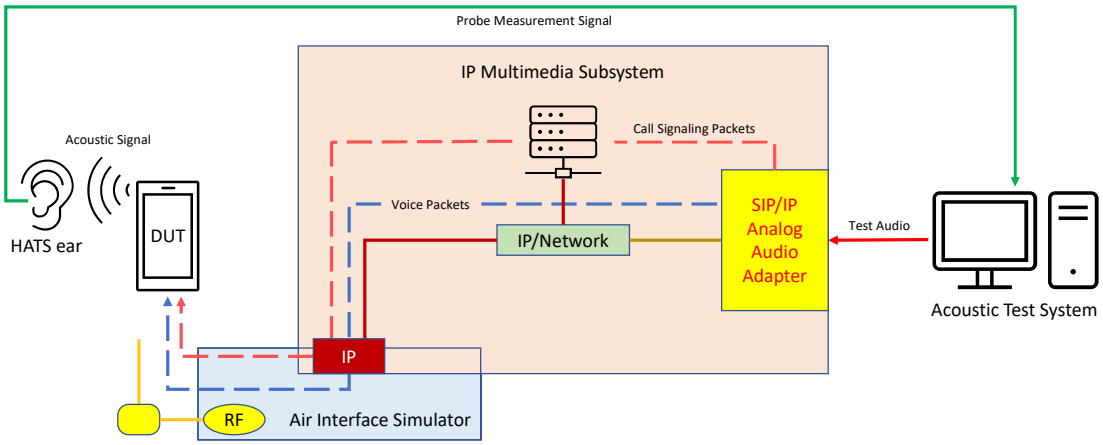



**Figure 5-1**
**Test Setup for VoLTE over IMS Volume Control Measurements**

### 2. Audio Level Settings

According to ANSI/TIA-5050-2018, the appropriate audio level to be used for VoLTE over IMS Volume Control testing is -20dBm0 (ASL) and shall be used for the normal speech input level. The CMW500 base station simulator was manually configured to ensure that the settings for speech input and full-scale levels resulted in the -20dBm0 (ASL) speech input level to the DUT for the VoLTE over IMS connection.

# II. DUT Configuration for VoLTE over IMS Volume Control Testing

## 1. Radio Configuration

An investigation was performed to ensure the modulation and RB configuration used for testing do not substantially affect the measurement results. The effects of modulation and RB configuration were found to be independent of band and bandwidth; therefore, only one band and bandwidth were used for this investigation. QPSK, 1RB, 0RB offset was used as the default testing configuration for the handset given the results of this investigation. See below table for comparison between different radio configurations:

**Table 5-1**
**VoLTE over IMS Results by Radio Configuration**

| Mode | RF Bandwidth (MHz) | Radio Configuration (Modulation/RB/RB offset) | Channel | HAC Mode | Mounting Force (N) | Codec Type | Codec Bandwidth | Codec Bitrate (kbps) | Volume Level | DRP Translation | Ambient Noise (dBA) | Distortion Margin (dB) | FR Margin (dB) | Conversational Gain (dB) | FCC CG Limit (dB) | CG Margin (dB) | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LTE Band 25 | 20 | QPSK/1RB/0RB offset | 26365 | On | 2 | EVS | NB | 24.40 | MAX -1 | DF | 33.88 | 8.29 | 3.43 | 13.53 | 6.00 | **7.53** | PASS |
| | | 16QAM/1RB/0RB offset | | | | | | | | DF | 33.88 | 5.34 | 3.32 | 12.86 | 6.00 | **6.86** | PASS |
| | | 64QAM/1RB/0RB offset | | | | | | | | DF | 33.88 | 5.88 | 3.46 | 12.92 | 6.00 | **6.92** | PASS |
| | | 256QAM/1RB/0RB offset | | | | | | | | FF | 32.15 | 10.49 | 3.28 | 14.12 | 6.00 | **8.12** | PASS |
| | | QPSK/1RB/50RB offset | | | | | | | | DF | 33.88 | 7.38 | 3.29 | 13.64 | 6.00 | **7.64** | PASS |
| | | QPSK/1RB/99RB offset | | | | | | | | DF | 33.88 | 8.87 | 3.50 | 13.61 | 6.00 | **7.61** | PASS |
| | | QPSK/50RB/0RB offset | | | | | | | | DF | 33.88 | 8.18 | 3.42 | 13.65 | 6.00 | **7.65** | PASS |
| | | QPSK/50RB/25RB offset | | | | | | | | DF | 33.88 | 7.09 | 3.38 | 13.58 | 6.00 | **7.58** | PASS |
| | | QPSK/50RB/50RB offset | | | | | | | | DF | 33.88 | 8.70 | 3.35 | 13.94 | 6.00 | **7.94** | PASS |
| | | QPSK/100RB/0RB offset | | | | | | | | DF | 33.88 | 6.22 | 3.45 | 13.71 | 6.00 | **7.71** | PASS |

## 2. Band Configuration

An investigation was performed to ensure the LTE band used for testing does not substantially affect the measurement results. NB EVS 24.40KBPS codec was used for evaluation. The effects of band configuration were found to be independent of radio configuration; therefore, only one radio configuration was used for this investigation. LTE B66 Antenna Config G was used as the default test band for VoLTE over IMS Volume Control testing given the results of this investigation. See below table for comparisons between different bands:

**Table 5-2**
**VoLTE over IMS Results by Band**

| Mode | Antenna Configuration | RF Bandwidth (MHz) | Channel | HAC Mode | Mounting Force (N) | Codec Type | Codec Bandwidth | Codec Bitrate (kbps) | Volume Level | Ambient Noise (dBA) | Conversational Gain (dB) | FCC CG Limit (dB) | CG Margin (dB) | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LTE Band 4** | G | 20 | 20175 | On | 2 | EVS | NB | 24.40 | MAX -1 | 32.15 | 14.36 | 6.00 | **8.36** | PASS |
| **LTE Band 66** | G | 20 | 132322 | | | | | | | 32.15 | 14.34 | 6.00 | **8.34** | PASS |
| | | | | | | | | | | | | | | |
| **LTE Band 2** | G | 20 | 18900 | On | 2 | EVS | NB | 24.40 | MAX -1 | 32.15 | 14.63 | 6.00 | **8.63** | PASS |
| **LTE Band 25** | G | 20 | 26365 | | | | | | | 32.15 | 14.60 | 6.00 | **8.60** | PASS |
| | | | | | | | | | | | | | | |
| **LTE Band 30** | G | 10 | 27710 | On | 2 | EVS | NB | 24.40 | MAX -1 | 32.15 | 13.93 | 6.00 | **7.93** | PASS |
| **LTE Band 7** | G | 20 | 21100 | | | | | | | 32.15 | 13.93 | 6.00 | **7.93** | PASS |
| **LTE Band 41 (PC3)** | G | 20 | 40620 | | | | | | | 32.15 | 14.60 | 6.00 | **8.60** | PASS |

# 6. VONR TEST SYSTEM SETUP AND DUT CONFIGURATION

## I. Test System Setup for VoNR over IMS T-coil Testing

### 1. Equipment Setup

The general test setup used for VoNR over IMS is shown below. The callboxes used when performing VoNR over IMS Volume Control measurements are a CMX OBT. The Data Application Unit (DAU) of the CMX OBT was used to simulate the IP Multimedia Subsystem (IMS) server. The CMX OBT provided the baseband signal to perform NR signaling. An external USB audio interface is used to perform the A/D conversion and ensure proper speech input level to the DUT.

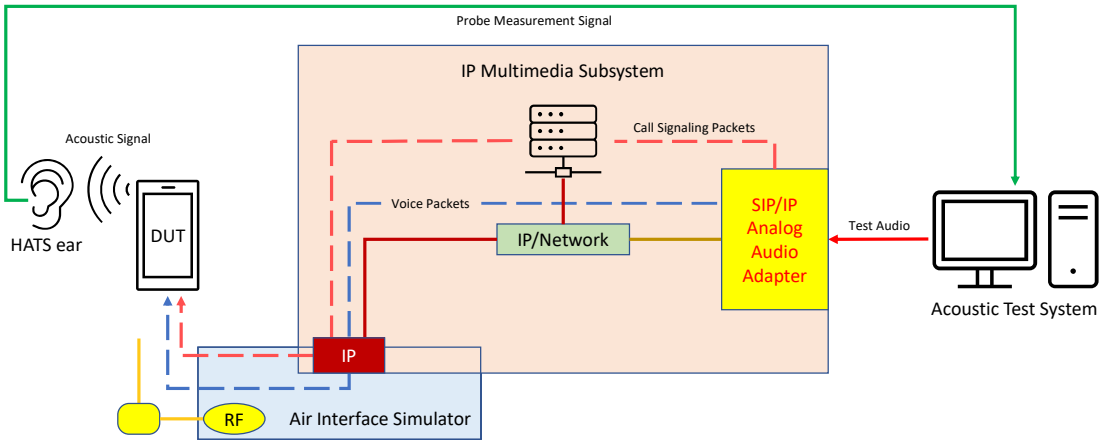



**Figure 6-1**
**Test Setup for VoNR over IMS Volume Control Measurements**

### 2. Audio Level Settings

According to ANSI/TIA-5050-2018, the appropriate audio level to be used for VoNR over IMS Volume Control testing is -20dBm0 (ASL) and shall be used for the normal speech input level. The acoustic test system was manually configured to ensure that the settings for speech input and full scale levels resulted in the -20dBm0 (ASL) speech input level to the DUT for the VoNR over IMS connection.

# II. DUT Configuration for VoNR over IMS Volume Control Testing

## 1. Radio Configuration

An investigation was performed to ensure the waveform, modulation, and RB configuration used for testing do not substantially affect the measurement results. The effects of waveform, modulation, and RB configuration were found to be independent of band and bandwidth; therefore, only one band and bandwidth were used for this investigation. CP-OFDM, QPSK, 216RB, 0RB offset was used as the default testing configuration for the handset given the results of this investigation. See below table for comparison between different radio configurations:

**Table 6-1**
**VoNR over IMS Results by Radio Configuration – CP-OFDM**

| Mode | Waveform | Radio Configuration (Modulation/RB/RB offset) | RF Bandwidth (MHz) | Channel | HAC Mode | Mounting Force (N) | Codec Type | Codec Bandwidth | Codec Bitrate (kbps) | Volume Level | DRP Translation | Ambient Noise (dBA) | Distortion Margin (dB) | FR Margin (dB) | Conversational Gain (dB) | FCC CG Limit (dB) | CG Margin (dB) | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NR n66 | CP-OFDM | QPSK/1RB/1RB offset | 40 | 349000 | On | 2 | EVS | NB | 24.40 | MAX -1 | DF | 32.15 | 7.94 | 3.26 | 14.06 | 6.00 | **8.06** | PASS |
| | | 16QAM/1RB/1RB offset | | | | | | | | | DF | 32.15 | 7.38 | 3.31 | 13.89 | 6.00 | **7.89** | PASS |
| | | 64QAM/1RB/1RB offset | | | | | | | | | DF | 32.15 | 12.44 | 3.43 | 13.91 | 6.00 | **7.91** | PASS |
| | | 256QAM/1RB/1RB offset | | | | | | | | | DF | 32.15 | 10.10 | 3.40 | 14.30 | 6.00 | **8.30** | PASS |
| | | QPSK/1RB/108RB offset | | | | | | | | | DF | 32.15 | 10.92 | 3.41 | 13.86 | 6.00 | **7.86** | PASS |
| | | QPSK/1RB/214RB offset | | | | | | | | | DF | 32.15 | 6.16 | 3.20 | 13.63 | 6.00 | **7.63** | PASS |
| | | QPSK/108RB/0RB offset | | | | | | | | | DF | 32.15 | 11.53 | 3.53 | 13.50 | 6.00 | **7.50** | PASS |
| | | QPSK/108RB/54RB offset | | | | | | | | | DF | 32.15 | 8.34 | 3.57 | 13.45 | 6.00 | **7.45** | PASS |
| | | QPSK/108RB/108RB offset | | | | | | | | | DF | 32.15 | 7.97 | 3.49 | 13.80 | 6.00 | **7.80** | PASS |
| | | QPSK/216RB/0RB offset | | | | | | | | | DF | 32.15 | 8.16 | 3.40 | 13.41 | 6.00 | **7.41** | PASS |

**Table 6-2**
**VoNR over IMS Results by Radio Configuration – DFT-s-OFDM**

| Mode | Waveform | Radio Configuration (Modulation/RB/RB offset) | RF Bandwidth (MHz) | Channel | HAC Mode | Mounting Force (N) | Codec Type | Codec Bandwidth | Codec Bitrate (kbps) | Volume Level | DRP Translation | Ambient Noise (dBA) | Distortion Margin (dB) | FR Margin (dB) | Conversational Gain (dB) | FCC CG Limit (dB) | FCC Margin from Limit (dB) | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NR n66 | DFT-s-OFDM | BPSK/1RB/1RB offset | 40 | 349000 | On | 2 | EVS | NB | 24.40 | MAX -1 | DF | 32.15 | 8.38 | 3.51 | 14.29 | 6.00 | **8.29** | PASS |
| | | QPSK/1RB/1RB offset | | | | | | | | | DF | 32.15 | 8.31 | 3.18 | 14.19 | 6.00 | **8.19** | PASS |
| | | 16QAM/1RB/1RB offset | | | | | | | | | DF | 32.15 | 6.44 | 3.55 | 13.90 | 6.00 | **7.90** | PASS |
| | | 64QAM/1RB/1RB offset | | | | | | | | | DF | 32.15 | 7.08 | 3.45 | 13.83 | 6.00 | **7.83** | PASS |
| | | 256QAM/1RB/1RB offset | | | | | | | | | DF | 32.15 | 8.43 | 3.37 | 13.58 | 6.00 | **7.58** | PASS |
| | | QPSK/1RB/108RB offset | | | | | | | | | DF | 32.15 | 8.67 | 3.31 | 13.94 | 6.00 | **7.94** | PASS |
| | | QPSK/1RB/214RB offset | | | | | | | | | DF | 32.15 | 8.04 | 3.42 | 13.99 | 6.00 | **7.99** | PASS |
| | | QPSK/108RB/0RB offset | | | | | | | | | DF | 32.15 | 7.13 | 3.25 | 13.63 | 6.00 | **7.63** | PASS |
| | | QPSK/108RB/54RB offset | | | | | | | | | DF | 32.15 | 8.51 | 3.22 | 13.70 | 6.00 | **7.70** | PASS |
| | | QPSK/108RB/108RB offset | | | | | | | | | DF | 32.15 | 7.41 | 3.60 | 14.01 | 6.00 | **8.01** | PASS |
| | | QPSK/216RB/0RB offset | | | | | | | | | DF | 32.15 | 11.56 | 3.32 | 13.94 | 6.00 | **7.94** | PASS |

## 2. Band Configuration

An investigation was performed to ensure the NR band used for testing does not substantially affect the measurement results. NB EVS 24.40KBPS codec was used for evaluation. The effects of band configuration were found to be independent of radio configuration; therefore, only one radio configuration was used for this investigation. NR n66 Antenna Config G was used as the default test band for VoNR over IMS Volume Control testing given the results of this investigation. See below table for comparisons between different bands:

**Table 6-3**
**VoNR over IMS Results by Band**

| Mode | Antenna Config | RF Bandwidth (MHz) | Channel | HAC Mode | Mounting Force (N) | Codec Type | Codec Bandwidth | Codec Bitrate | Ambient Noise (dBA) | Conversational Gain (CG) (dB) | FCC CG Limit (dB) | CG Margin (dB) | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NR n70** | G | 15 | 340500 | On | 2 | EVS | NB | 24.40 | 32.15 | 13.79 | 6.00 | **7.79** | PASS |
| **NR n66** | G | 40 | 349000 | | | | | | 32.15 | 14.63 | 6.00 | **8.63** | PASS |
| | | | | | | | | | | | | | |
| **NR n25** | G | 40 | 376500 | On | 2 | EVS | NB | 24.40 | 32.15 | 14.32 | 6.00 | **8.32** | PASS |
| | | | | | | | | | | | | | |
| **NR n30** | G | 10 | 462000 | On | 2 | EVS | NB | 24.40 | 32.15 | 14.55 | 6.00 | **8.55** | PASS |
| **NR n7** | G | 40 | 507000 | | | | | | 32.15 | 14.64 | 6.00 | **8.64** | PASS |
| **NR n41 (PC2)** | G | 100 | 518598 | | | | | | 32.15 | 14.34 | 6.00 | **8.34** | PASS |
| **NR n41 (PC2)** | PC 1.5 UL MIMO | 100 | 518598 | | | | | | 32.15 | 13.76 | 6.00 | **7.76** | PASS |

# 7. INTERIM WAIVER DA 23-914

A. Under the waiver, only CMRS narrowband and CMRS wideband voice codecs are required to comply with the Volume Control requirements of the TIA 5050-2018 Volume Control Standard as amended as follows:

B. For the 2N mounting force test, one narrowband and one wideband voice codec embedded with the handset must pass with at least one volume control setting with a Receive Conversational Gain of ≥ 6 dB for all voice services, bands of operation and air interfaces over which it operates using one codec bit rate of the applicant's choosing.

C. For the 8N mounting force test, one narrowband and one wideband voice codec embedded with the handset must pass with at least one volume control setting with a Receive Conversational Gain of ≥ 6 dB for all voice services, bands of operation and air interfaces over which they operate but is not required to meet or exceed the full 18 dB of Receive Conversational Gain specified in section 5.1.1 of the TIA 5050 Volume Control Standard using one codec bit rate of the applicant's choosing.

D. For all other narrowband and wideband codecs not evaluated in 1.a. above, TIA 5050-2018 Receive Distortion and Noise Performance and Receive Acoustic Receive Frequency Response Performance evaluations are not required; however, these codecs shall be assessed for Receive Conversational Gain and documented in the test report at the 2N and 8N levels with a gain of ≥ 6 dB for all voice services, bands of operation and air interfaces over which they operate. The handset volume setting used to comply with 1.a. shall be used for these other CMRS codec evaluations.

E. Any other codec for voice services embedded in the handset, not identified in section I and II above are not required to comply or demonstrate in the test reports for Receive Conversational Gain.

F. Under the waiver, the manufacturer has chosen NB-EVS 24.4kbps and WB-EVS 128kbps audio codec bitrates for full evaluation.

# 8. VOLUME CONTROL TEST SUMMARY

**Table 8-1**
**Consolidated Tabled Results**

| | Conversational Gain (CG) (dB) | | FR Margin (dB) | Distortion Margin (dB) | C63.19 Compliance |
|---|---|---|---|---|---|
| | 2N | 8N | | | |
| LTE | 13.0 | 14.7 | 1.1 | 7.0 | PASS |
| NR | 12.9 | 14.1 | 1.2 | 9.2 | PASS |

* The requirement that a handset achieve at least an 18 dB Receive Conversational Gain with 8N has been waived under the waiver conditions of DA-23-914.

1. Receive Conversational Gain with Hearing Aid: 13 dB
2. Receive Conversational Gain without Hearing Aid: 14 dB

# I. Raw Handset Data

## Table 8-2
## Raw Data Results for VoLTE – Folder Closed

| Mode | RF Bandwidth (MHz) | Radio Configuration (Modulation/RB/RB offset) | Channel | HAC Mode | Mounting Force (N) | Codec Type | Codec Bandwidth | Codec Bitrate (kbps) | Volume Level | DRP Translation | Ambient Noise (dBA) | Distortion Margin (dB) | FR Margin (dB) | Conversational Gain (dB) | FCC CG Limit (dB) | CG Margin (dB) | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LTE Band 25 | 20 | QPSK/100RB/0RB offset | 26365 | On | 2 | AMR | NB | 4.75 | MAX -1 | - | 33.88 | - | - | 13.44 | 6.00 | **7.44** | PASS |
| | | | | | | | | 12.20 | | - | 33.88 | - | - | 13.93 | 6.00 | **7.93** | PASS |
| | | | | | 8 | | | 4.75 | | - | 33.88 | - | - | 14.58 | 6.00 | **8.58** | PASS |
| | | | | | | | | 12.20 | | - | 33.88 | - | - | 15.18 | 6.00 | **9.18** | PASS |
| | | | | | 2 | | WB | 6.60 | | - | 33.88 | - | - | 13.78 | 6.00 | **7.78** | PASS |
| | | | | | | | | 12.65 | | - | 33.88 | - | - | 14.00 | 6.00 | **8.00** | PASS |
| | | | | | | | | 23.85 | | - | 33.88 | - | - | 13.87 | 6.00 | **7.87** | PASS |
| | | | | | 8 | | | 6.60 | | - | 33.88 | - | - | 15.27 | 6.00 | **9.27** | PASS |
| | | | | | | | | 12.65 | | - | 33.88 | - | - | 13.35 | 6.00 | **7.35** | PASS |
| | | | | | | | | 23.85 | | - | 33.88 | - | - | 14.88 | 6.00 | **8.88** | PASS |
| | | | | | 2 | EVS | NB | 5.90 | | - | 33.88 | - | - | 13.60 | 6.00 | **7.60** | PASS |
| | | | | | | | | 13.20 | | - | 33.88 | - | - | 14.10 | 6.00 | **8.10** | PASS |
| | | | | | | | | 24.40 | | DF | 33.88 | 7.35 | 3.65 | 13.53 | 6.00 | **7.53** | PASS |
| | | | | | 8 | | | 5.90 | | - | 33.88 | - | - | 14.77 | 6.00 | **8.77** | PASS |
| | | | | | | | | 13.20 | | - | 33.88 | - | - | 14.85 | 6.00 | **8.85** | PASS |
| | | | | | | | | 24.40 | | DF | 33.88 | 7.00 | 3.11 | 14.72 | 6.00 | **8.72** | PASS |
| | | | | | 2 | | WB | 5.90 | | - | 33.88 | - | - | 13.82 | 6.00 | **7.82** | PASS |
| | | | | | | | | 13.20 | | - | 33.88 | - | - | 14.03 | 6.00 | **8.03** | PASS |
| | | | | | | | | 128.00 | | DF | 33.88 | 11.32 | 2.40 | 14.14 | 6.00 | **8.14** | PASS |
| | | | | | 8 | | | 5.90 | | - | 33.88 | - | - | 14.98 | 6.00 | **8.98** | PASS |
| | | | | | | | | 13.20 | | - | 33.88 | - | - | 14.87 | 6.00 | **8.87** | PASS |
| | | | | | | | | 128.00 | | DF | 33.88 | 10.95 | 2.53 | 15.31 | 6.00 | **9.31** | PASS |

## Table 8-3
## Raw Data Results for VoLTE – Folder Open

| Mode | RF Bandwidth (MHz) | Radio Configuration (Modulation/RB/RB offset) | Channel | HAC Mode | Mounting Force (N) | Codec Type | Codec Bandwidth | Codec Bitrate (kbps) | Volume Level | DRP Translation | Ambient Noise (dBA) | Distortion Margin (dB) | FR Margin (dB) | Conversational Gain (dB) | FCC CG Limit (dB) | CG Margin (dB) | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LTE Band 25 | 20 | QPSK/1RB/0RB offset | 26365 | On | 2 | EVS | NB | 24.40 | MAX -1 | DF | 32.15 | 7.81 | 3.09 | 13.02 | 6.00 | **7.02** | PASS |
| | | | | | 8 | | | | | DF | 32.15 | 8.16 | 2.89 | 14.66 | 6.00 | **8.66** | PASS |
| | | | | | 2 | | WB | 128.00 | | DF | 32.15 | 10.15 | 1.49 | 13.58 | 6.00 | **7.58** | PASS |
| | | | | | 8 | | | | | DF | 32.15 | 10.10 | 1.12 | 14.81 | 6.00 | **8.81** | PASS |

## Table 8-4
## Raw Data Results for VoNR – Folder Closed

| Mode | Waveform | Radio Configuration (Modulation/RB/RB offset) | RF Bandwidth (MHz) | Channel | HAC Mode | Mounting Force (N) | Codec Type | Codec Bandwidth | Codec Bitrate (kbps) | Volume Level | DRP Translation | Ambient Noise (dBA) | Distortion Margin (dB) | FR Margin (dB) | Conversational Gain (dB) | FCC CG Limit (dB) | CG Margin (dB) | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NR n66 | CP-OFDM | QPSK/216RB/0RB offset | 40 | 349000 | On | 2 | AMR | NB | 4.75 | MAX -1 | - | 32.15 | - | - | 13.86 | 6.00 | **7.86** | PASS |
| | | | | | | | | | 12.20 | | - | 32.15 | - | - | 13.93 | 6.00 | **7.93** | PASS |
| | | | | | 8 | | | | 4.75 | | - | 32.15 | - | - | 15.28 | 6.00 | **9.28** | PASS |
| | | | | | | | | | 12.20 | | - | 32.15 | - | - | 15.04 | 6.00 | **9.04** | PASS |
| | | | | | 2 | | WB | | 6.60 | | - | 32.15 | - | - | 13.74 | 6.00 | **7.74** | PASS |
| | | | | | | | | | 12.65 | | - | 32.15 | - | - | 13.79 | 6.00 | **7.79** | PASS |
| | | | | | | | | | 23.85 | | - | 32.15 | - | - | 13.90 | 6.00 | **7.90** | PASS |
| | | | | | 8 | | | | 6.60 | | - | 32.15 | - | - | 15.26 | 6.00 | **9.26** | PASS |
| | | | | | | | | | 12.65 | | - | 32.15 | - | - | 15.18 | 6.00 | **9.18** | PASS |
| | | | | | | | | | 23.85 | | - | 32.15 | - | - | 15.24 | 6.00 | **9.24** | PASS |
| | | | | | 2 | EVS | NB | | 5.90 | | - | 32.15 | - | - | 13.74 | 6.00 | **7.74** | PASS |
| | | | | | | | | | 13.20 | | - | 32.15 | - | - | 14.00 | 6.00 | **8.00** | PASS |
| | | | | | | | | | 24.40 | | DF | 32.15 | 8.17 | 3.28 | 14.16 | 6.00 | **8.16** | PASS |
| | | | | | 8 | | | | 5.90 | | - | 32.15 | - | - | 15.16 | 6.00 | **9.16** | PASS |
| | | | | | | | | | 13.20 | | - | 32.15 | - | - | 15.15 | 6.00 | **9.15** | PASS |
| | | | | | | | | | 24.40 | | DF | 32.15 | 11.84 | 2.96 | 15.55 | 6.00 | **9.55** | PASS |
| | | | | | 2 | | WB | | 5.90 | | - | 32.15 | - | - | 13.42 | 6.00 | **7.42** | PASS |
| | | | | | | | | | 13.20 | | - | 32.15 | - | - | 14.17 | 6.00 | **8.17** | PASS |
| | | | | | | | | | 128.00 | | DF | 32.15 | 10.42 | 2.48 | 13.93 | 6.00 | **7.93** | PASS |
| | | | | | 8 | | | | 5.90 | | - | 32.15 | - | - | 15.34 | 6.00 | **9.34** | PASS |
| | | | | | | | | | 13.20 | | - | 32.15 | - | - | 15.55 | 6.00 | **9.55** | PASS |
| | | | | | | | | | 128.00 | | DF | 32.15 | 10.44 | 2.50 | 15.41 | 6.00 | **9.41** | PASS |

## Table 8-5
## Raw Data Results for VoNR – Folder Open

| Mode | Waveform | Radio Configuration (Modulation/RB/RB offset) | RF Bandwidth (MHz) | Channel | HAC Mode | Mounting Force (N) | Codec Type | Codec Bandwidth | Codec Bitrate (kbps) | Volume Level | DRP Translation | Ambient Noise (dBA) | Distortion Margin (dB) | FR Margin (dB) | Conversational Gain (dB) | FCC CG Limit (dB) | CG Margin (dB) | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NR n66 | CP-OFDM | QPSK/216RB/0RB offset | 40 | 349000 | On | 2 | EVS | NB | 24.40 | MAX -1 | DF | 32.15 | 9.88 | 3.01 | 12.94 | 6.00 | **6.94** | PASS |
| | | | | | | 8 | | | | | DF | 32.15 | 9.19 | 2.97 | 14.11 | 6.00 | **8.11** | PASS |
| | | | | | | 2 | | WB | 128.00 | | DF | 32.15 | 10.09 | 1.80 | 13.25 | 6.00 | **7.25** | PASS |
| | | | | | | 8 | | | | | DF | 32.15 | 9.80 | 1.20 | 14.68 | 6.00 | **8.68** | PASS |

## II. Test Notes

A. General

1. DUT Condition: Mute off; Backlight off; Max Volume -1; Max Contrast
2. Test Signal: IEEE Std 269 uncompressed real male speech
3. Hearing Aid Mode: On (Menu Path: **Phone→Call Settings→Other Call Settings→Hearing aid compatibility**)
4. Bluetooth and WIFI were disabled while testing 4G/5G modes.
5. The FCC Margin from Limit column indicates a margin from the FCC limit for compliance.
6. FOLDER-OPEN was additionally tested to ensure acoustic consistency with the fully tested FOLDER-CLOSED configuration.

B. Voice over LTE

1. Power Configuration: TPC = “Max Power”
2. Radio Configuration: QPSK, 1RB, 0RB offset
3. Vocoder Configuration:
    a. AMR-NB: 4.75kbps, 12.2kbps
    b. AMR-WB: 6.60kbps,12.65kbps, 23.85kbps
    c. EVS-NB: 5.9kbps,13.2kbps, 24.4kbps
    d. EVS-WB: 5.9kbps, 24.4kbps, 128kbps

C. Voice over NR

1. Power Configuration: TPC = “Max Power”
2. Radio Configuration: CP-OFDM, QPSK, 216RB, 0RB offset
3. Vocoder Configuration:
    a. AMR-NB: 4.75kbps, 12.2kbps
    b. AMR-WB: 6.60kbps,12.65kbps, 23.85kbps
    c. EVS-NB: 5.9kbps,13.2kbps, 24.4kbps
    d. EVS-WB: 5.9kbps,13.2kbps, 128kbps

## III. Volume Control Verification Test Results

**Table 8-6**
**Verification Results Table**

| Date of Testing | Test Location | Air Interface Equipment | Acoustical Calibrator | HATS Sens. [dB] | Ambient Noise [dBA] |
|---|---|---|---|---|---|
| 05/09/2025 | Whisper1 | CMW500 | 2343018 | 97.00 | 33.88 |
| 05/12/2025 | Whisper1 | CMW500 | 2343018 | 96.97 | 32.15 |

# 9. MEASUREMENT UNCERTAINTY

**Table 9-1**
**Uncertainty Estimation Table**

| **Receive Volume Control Requirement** | Expanded uncertainty (k=2), 95% confidence level (dB) |
|---|---|
| Receive Conversational Gain | 0.33 |
| Receive Frequency Response (FF) | 0.23 |
| Receive Frequency Response (DF) | 0.19 |
| Receive Distortion and Noise | 0.81 |

Notes:

・Test equipment is calibrated according to techniques outlined in NIS81, NIS3003 and NIST Tech Note 1297.
・All equipment has traceability according to NIST. Measurement Uncertainties are defined in further detail in NIS 81 and NIST Tech Note 1297 and UKAS M3003.

Measurement uncertainty reflects the quality and accuracy of a measured result as compared to the true value. Such statements are generally required when stating results of measurements so that it is clear to the intended audience that the results may differ when reproduced by different facilities. Measurement results vary due to the measurement uncertainty of the instrumentation, measurement technique, and test engineer. Most uncertainties are calculated using the tolerances of the instrumentation used in the measurement, the measurement setup variability, and the technique used in performing the test. While not generally included, the variability of the equipment under test also figures into the overall measurement uncertainty. Another component of the overall uncertainty is based on the variability of repeated measurements (so-called Type A uncertainty). This may mean that the Hearing Aid compatibility tests may have to be repeated by taking down the test setup and resetting it up so that there are a statistically significant number of repeat measurements to identify the measurement uncertainty. The above uncertainties were estimated experimentally using the techniques contained in NIS 81 and NIS 3003.

# 10. EQUIPMENT LIST

**Table 10-1**
**Equipment List**

| Manufacturer | Model | Description | Cal Date | Cal Interval | Cal Due | Serial Number |
|---|---|---|---|---|---|---|
| Listen | SoundConnect | Microphone Power Supply | 1/8/2025 | Biennial | 1/8/2027 | 0899-PS150 |
| RME | Fireface UC | Soundcheck Acoustic Analyzer External Audio Interface | 1/8/2025 | Biennial | 1/8/2027 | 23792992 |
| Rohde & Schwarz | CMW500 | Radio Communication Tester | 8/10/2024 | Annual | 8/10/2025 | 140144 |
| Rohde & Schwarz | CMW500 | Radio Communication Tester | 10/15/2024 | Annual | 10/15/2025 | 162125 |
| Rohde & Schwarz | CMX OBT | Radio Communication Tester | 11/11/2024 | Annual | 11/11/2025 | 100298 |
| YellowTec | YT4211 | USB Audio Interface | N/A | | N/A | 20000365 |
| Seekonk | NC-100 | Torque Wrench (8" lb) | 4/2/2024 | Biennial | 4/2/2026 | N/A |
| Bruel & Kjaer (HBK) | 4128-D | Head and Torso Simulator | 4/29/2024 | Biennial | 4/29/2026 | 1947220 |
| Bruel & Kjaer (HBK) | 4158 | Right Ear Simulator | 5/1/2024 | Biennial | 5/1/2026 | 1886222/2025786 |
| Bruel & Kjaer (HBK) | 4231 | Acoustical Calibrator Type 4231 with UA1546 | 4/29/2024 | Biennial | 4/29/2026 | 2343018 |
| Bruel & Kjaer (HBK) | DZ-9769 | Artificial Ear | 9/15/2022 | Triennial | 9/15/2025 | SBM553623 |

# 11. TEST DATA

5/9/2025

element

## Element Hearing-Aid Compatibility Facility

# Whisper Room 1 / HATS

Type: HATS 4128
Serial: 1947220

**Measurement Standard:** ANSI C63.19-2019

**Equipment:**

- Head and Torso Simulator Type 4128: SN: 1947220; Calibrated: 4/29/2024
- Acoustical Calibrator Type 4231 W/ UA1546: SN 2343018; Calibrated: 4/29/2024

### System Verification CMRS

| | | | | |
|---|---|---|---|---|
| Ambient Noise Level Check (Analysis) | 27.64 dB | ✓ | Maximum | 40 |
| Ambient Noise Level Check (RTA) | 33.88 dB | ✓ | Maximum | 40 |
| Ambient Noise Level Check (Voltmeter) | 26.24 dB | ✓ | Maximum | 40 |
| CMW500 0dBm0 Level Check | 999m V | ✓ | Max/Min | 1/900m |
| HATS Sensitivity Check | 97 dB | ✓ | Max/Min | 97.3/96.9 |

5/12/2025

element

## Element Hearing-Aid Compatibility Facility

# Whisper Room 1 / HATS

Type: HATS 4128
Serial: 1947220

**Measurement Standard:** ANSI C63.19-2019

**Equipment:**

- Head and Torso Simulator Type 4128: SN: 1947220; Calibrated: 4/29/2024
- Acoustical Calibrator Type 4231 W/ UA1546: SN 2343018; Calibrated: 4/29/2024

### System Verification CMRS

| | | | | |
|---|---|---|---|---|
| Ambient Noise Level Check (Analysis) | 30.49 dB | ✓ | Maximum | 40 |
| Ambient Noise Level Check (RTA) | 32.15 dB | ✓ | Maximum | 40 |
| Ambient Noise Level Check (Voltmeter) | 30.37 dB | ✓ | Maximum | 40 |
| CMW500 0dBm0 Level Check | 999m V | ✓ | Max/Min | 1/900m |
| HATS Sensitivity Check | 96.97 dB | ✓ | Max/Min | 97.3/96.9 |

5/9/2025

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

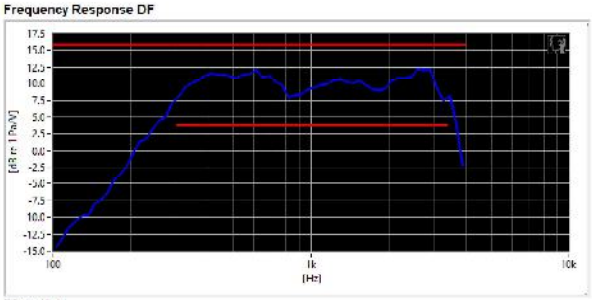
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

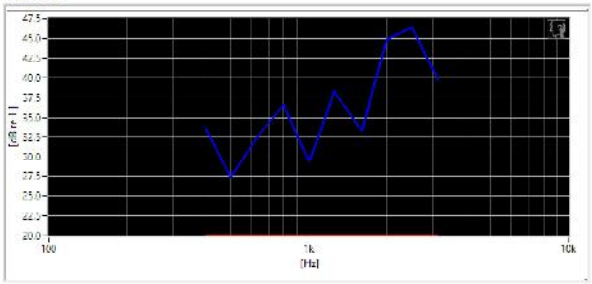
**Test Configuration:**

- Mode: LTE Band 25
- Bandwidth: 20MHz
- Channel: 26365
- Codec Bandwidth: Narrowband
- Mounting Force: 2N
- DUT Orientation: Folder Closed

Frequency Response DF




Distortion




Results DF

| | | | | |
|---|---|---|---|---|
| Conversational Gain (2N) | 18.53 dB | ✓ | Minimum | 6 |
| Distortion Value (NB) | 27.35 dB | ✓ | Minimum | 20 |
| Distortion Margin (NB) | 7.35 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, NB) | 3.65 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

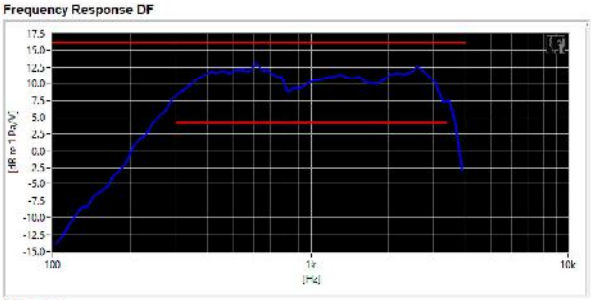
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

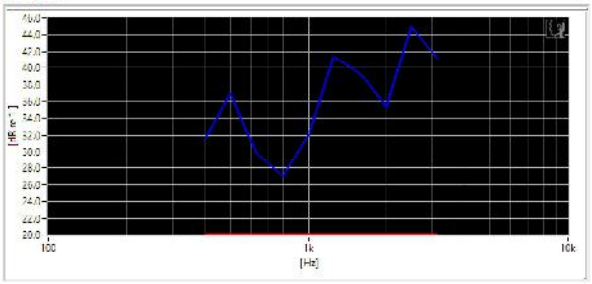
**Test Configuration:**

- Mode: LTE Band 25
- Bandwidth: 20MHz
- Channel: 26365
- Codec Bandwidth: Narrowband
- Mounting Force: 8N
- DUT Orientation: Folder Closed

**Frequency Response DF**




**Distortion**




**Results DF**

| | | | | |
|---|---|---|---|---|
| Conversational Gain (HN) | 14.62 dB | ✓ | Minimum | 6 |
| Distortion Value (NB) | 27 dB | ✓ | Minimum | 20 |
| Distortion Margin (NB) | 7 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, NB) | 3.11 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

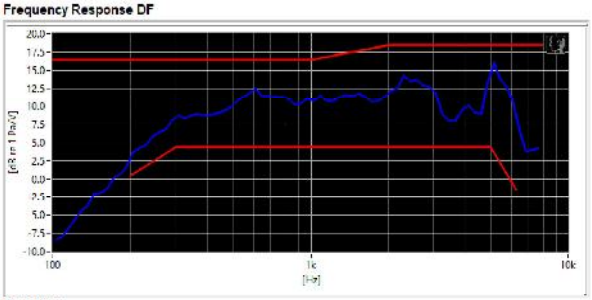
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

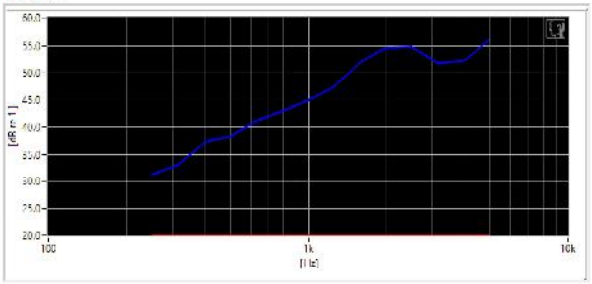
**Test Configuration:**

- Mode: LTE Band 25
- Bandwidth: 20MHz
- Channel: 26365
- Codec Bandwidth: Wideband
- Mounting Force: 2N
- DUT Orientation: Folder Closed

**Frequency Response DF**




**Distortion**




**Results DF**

| | | | | |
|---|---|---|---|---|
| Conversational Gain (2N) | 14.14 dB | ✓ | Minimum | 0 |
| Distortion Value (WB) | [illegible] dB | ✓ | Minimum | 20 |
| Distortion Margin (WB) | 11.32 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, WB) | 2.4 dB | ✓ | Tolerance curves | Floating Limits |

element

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

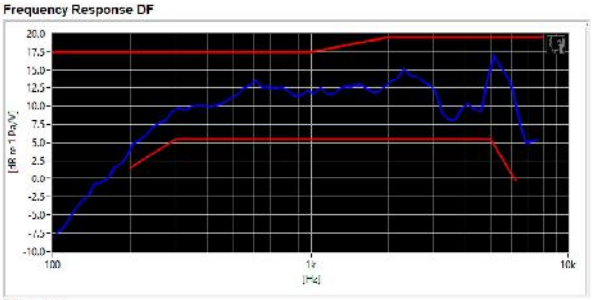
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

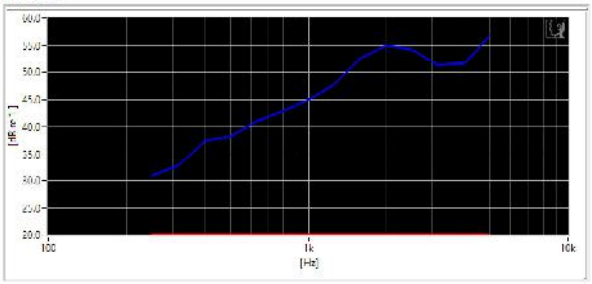
**Test Configuration:**

- Mode: LTE Band 25
- Bandwidth: 20MHz
- Channel: 26365
- Codec Bandwidth: Wideband
- Mounting Force: 8N
- DUT Orientation: Folder Closed

**Frequency Response DF**




**Distortion**




**Results DF**

| | | | | |
|---|---|---|---|---|
| Conversational Gain (IIN) | 15.11 dB | ✓ | Minimum | 6 |
| Distortion Value (WB) | 30.95 dB | ✓ | Minimum | 20 |
| Distortion Margin (WB) | 10.95 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, WB) | 2.53 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

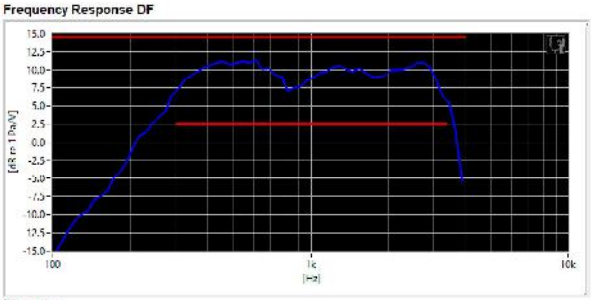
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

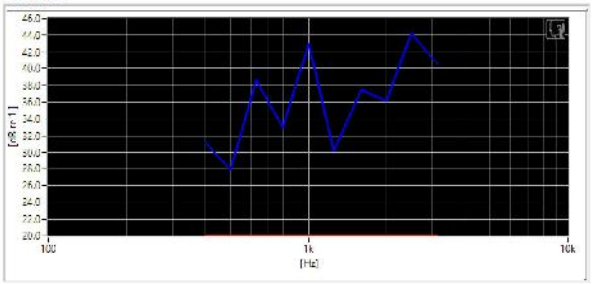
**Test Configuration:**

- Mode: LTE Band 25
- Bandwidth: 20MHz
- Channel: 26365
- Codec Bandwidth: Narrowband
- Mounting Force: 2N
- DUT Orientation: Folder Open

Frequency Response DF




Distortion




Results DF

| | | | | |
|---|---|---|---|---|
| Conversational Gain (2N) | 13.02 dB | ✓ | Minimum | 6 |
| Distortion Value (NB) | 27.81 dB | ✓ | Minimum | 20 |
| Distortion Margin (NB) | 7.81 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, NB) | 3.09 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

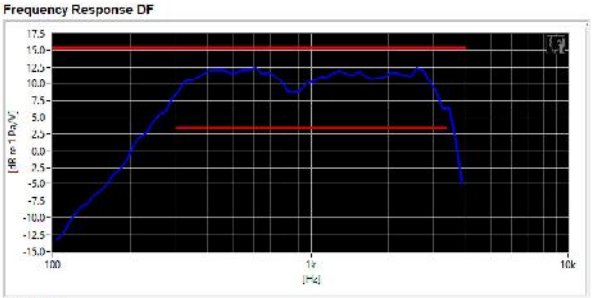
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

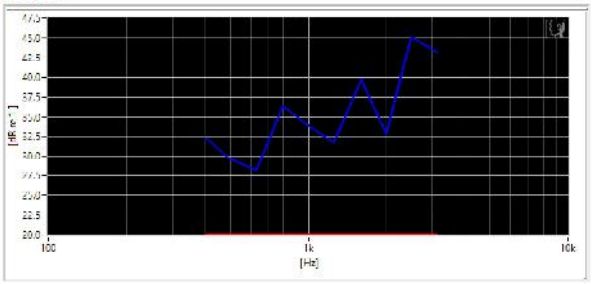
**Test Configuration:**

- Mode: LTE Band 25
- Bandwidth: 20MHz
- Channel: 26365
- Codec Bandwidth: Narrowband
- Mounting Force: 8N
- DUT Orientation: Folder Open

**Frequency Response DF**




**Distortion**




**Results DF**

| | | | | |
|---|---|---|---|---|
| Conversational Gain (IIN) | 14.66 dB | ✓ | Minimum | 6 |
| Distortion Value (NB) | 28.16 dB | ✓ | Minimum | 20 |
| Distortion Margin (NB) | 8.16 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, NB) | 2.89 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

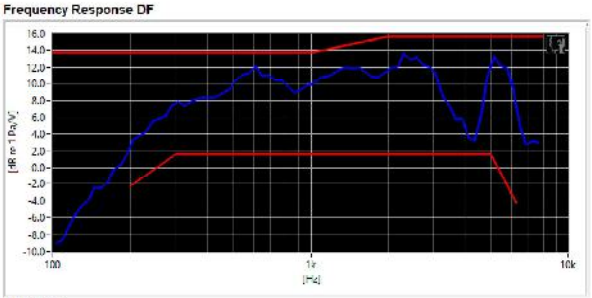
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

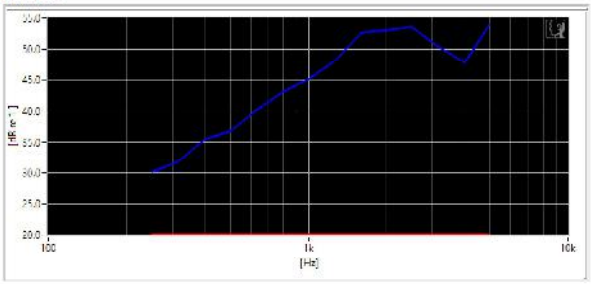
**Test Configuration:**

- Mode: LTE Band 25
- Bandwidth: 20MHz
- Channel: 26365
- Codec Bandwidth: Wideband
- Mounting Force: 2N
- DUT Orientation: Folder Open

**Frequency Response DF**




**Distortion**




**Results DF**

| | | | | |
|---|---|---|---|---|
| Conversational Gain (VN) | 11.50 dB | ✓ | Minimum | 6 |
| Distortion Value (WB) | 30.15 dB | ✓ | Minimum | 20 |
| Distortion Margin (WB) | 10.15 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, WB) | 1.49 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

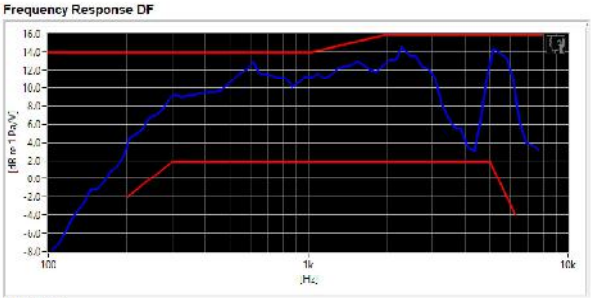
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

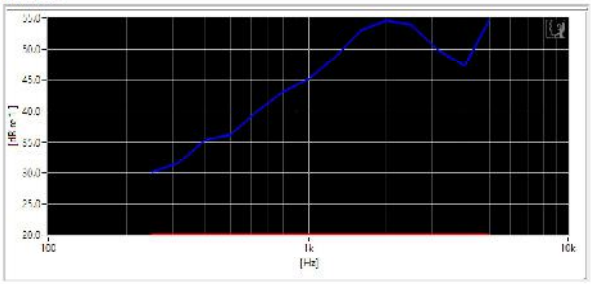
**Test Configuration:**

- Mode: LTE Band 25
- Bandwidth: 20MHz
- Channel: 26365
- Codec Bandwidth: Wideband
- Mounting Force: 8N
- DUT Orientation: Folder Open

**Frequency Response DF**




**Distortion**




**Results DF**

| | | | | |
|---|---|---|---|---|
| Conversational Gain (IIN) | 14.81 dB | ✓ | Minimum | 6 |
| Distortion Value (WB) | 30.1 dB | ✓ | Minimum | 20 |
| Distortion Margin (WB) | 10.1 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, WB) | 1.12 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

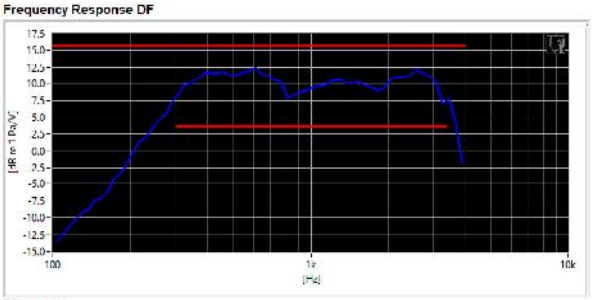
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

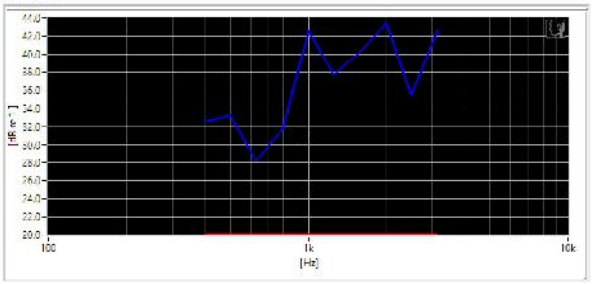
**Test Configuration:**

- Mode: NR Band n66
- Bandwidth: 40MHz
- Channel: 349000
- Codec Bandwidth: Narrowband
- Mounting Force: 2N
- DUT Orientation: Folder Closed

**Frequency Response DF**




**Distortion**




**Results DF**

| | | | | |
|---|---|---|---|---|
| Conversational Gain (VN) | 14.16 dB | ✓ | Minimum | 6 |
| Distortion Value (NB) | 28.17 dB | ✓ | Minimum | 20 |
| Distortion Margin (NB) | 8.17 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, NB) | 3.26 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

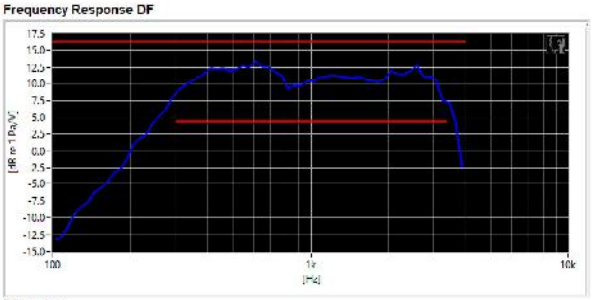
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

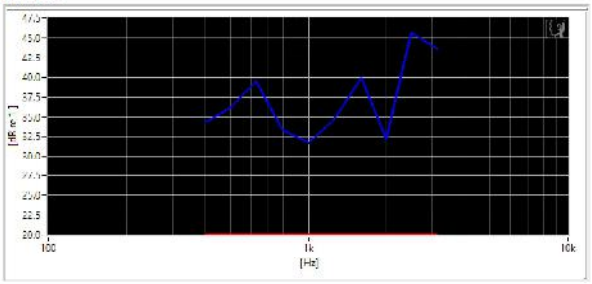
**Test Configuration:**

- Mode: NR Band n66
- Bandwidth: 40MHz
- Channel: 349000
- Codec Bandwidth: Narrowband
- Mounting Force: 8N
- DUT Orientation: Folder Closed

**Frequency Response DF**




**Distortion**




**Results DF**

| | | | | |
|---|---|---|---|---|
| Conversational Gain (IIN) | 15.55 dB | ✓ | Minimum | 6 |
| Distortion Value (NB) | 31.84 dB | ✓ | Minimum | 20 |
| Distortion Margin (NB) | 11.84 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, NB) | 2.96 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

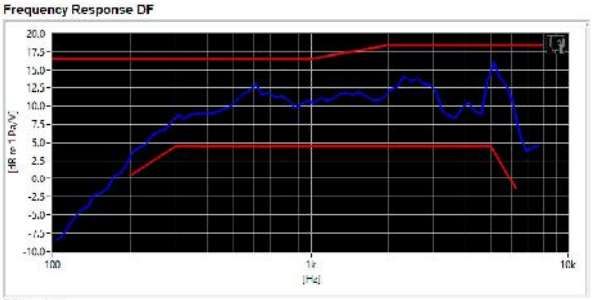
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

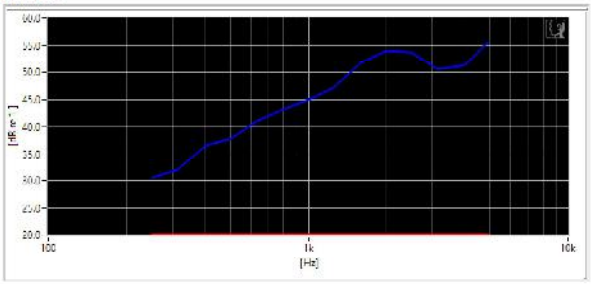
**Test Configuration:**

- Mode: NR Band n66
- Bandwidth: 40MHz
- Channel: 349000
- Codec Bandwidth: Wideband
- Mounting Force: 2N
- DUT Orientation: Folder Closed

**Frequency Response DF**




**Distortion**




**Results DF**

| | | | | |
|---|---|---|---|---|
| Conversational Gain (VN) | 11.91 dB | ✓ | Minimum | 6 |
| Distortion Value (WB) | 30.42 dB | ✓ | Minimum | 20 |
| Distortion Margin (WB) | 10.42 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, WB) | 2.48 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

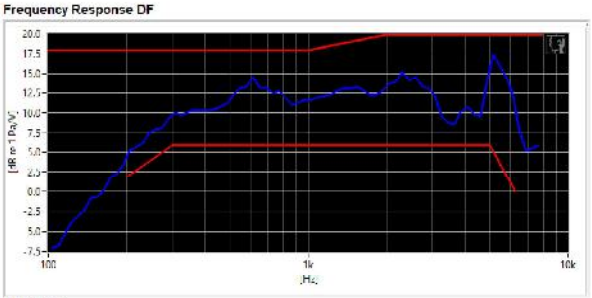
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

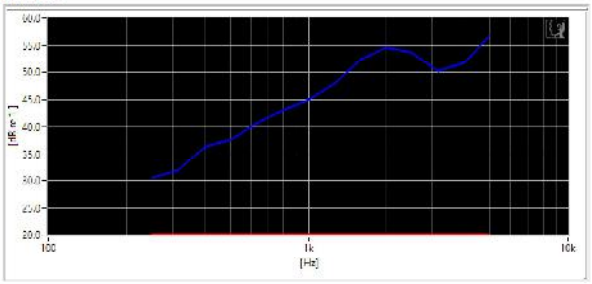
**Test Configuration:**

- Mode: NR Band n66
- Bandwidth: 40MHz
- Channel: 349000
- Codec Bandwidth: Wideband
- Mounting Force: 8N
- DUT Orientation: Folder Closed

**Frequency Response DF**




**Distortion**




**Results DF**

| | | | | |
|---|---|---|---|---|
| Conversational Gain (IIN) | 15.41 dB | ✓ | Minimum | 6 |
| Distortion Value (WB) | 30.44 dB | ✓ | Minimum | 20 |
| Distortion Margin (WB) | 10.44 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, WB) | 2.5 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

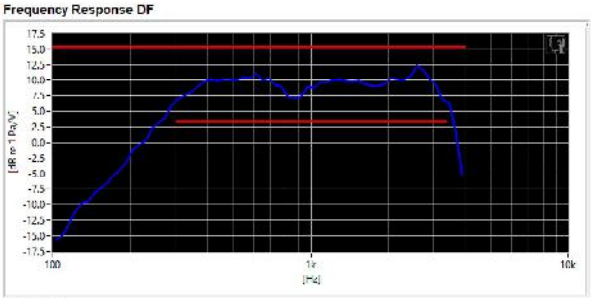
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

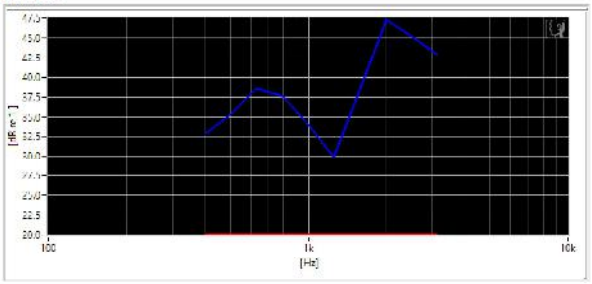
**Test Configuration:**

- Mode: NR Band n66
- Bandwidth: 40MHz
- Channel: 349000
- Codec Bandwidth: Narrowband
- Mounting Force: 2N
- DUT Orientation: Folder Open

Frequency Response DF




Distortion




Results DF

| | | | | |
|---|---|---|---|---|
| Conversational Gain (VN) | 17.94 dB | ✓ | Minimum | 6 |
| Distortion Value (NB) | 29.88 dB | ✓ | Minimum | 20 |
| Distortion Margin (NB) | 9.88 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, NB) | 3.01 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

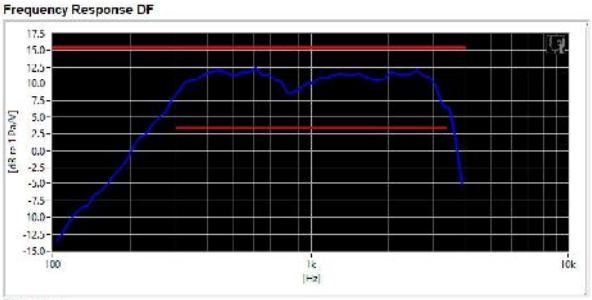
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

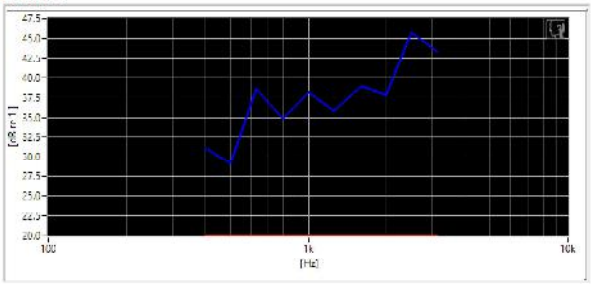
**Test Configuration:**

- Mode: NR Band n66
- Bandwidth: 40MHz
- Channel: 349000
- Codec Bandwidth: Narrowband
- Mounting Force: 8N
- DUT Orientation: Folder Open

Frequency Response DF




Distortion




Results DF

| | | | | |
|---|---|---|---|---|
| Conversational Gain (8N) | 14.11 dB | ✓ | Minimum | 0 |
| Distortion Value (NB) | 29.19 dB | ✓ | Minimum | 20 |
| Distortion Margin (NB) | 9.19 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, NB) | 2.97 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

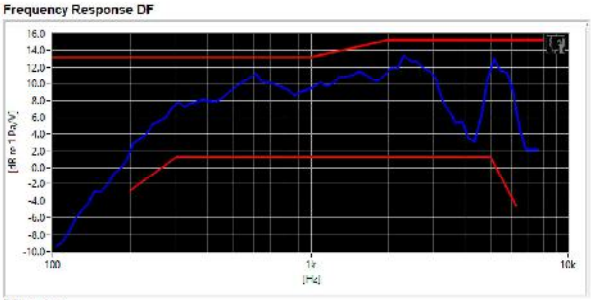
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

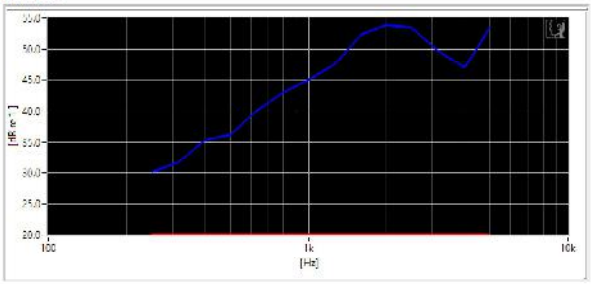
**Test Configuration:**

- Mode: NR Band n66
- Bandwidth: 40MHz
- Channel: 349000
- Codec Bandwidth: Wideband
- Mounting Force: 2N
- DUT Orientation: Folder Open

**Frequency Response DF**




**Distortion**




**Results DF**

| | | | | |
|---|---|---|---|---|
| Conversational Gain (VN) | 11.25 dB | ✓ | Minimum | 6 |
| Distortion Value (WB) | 30.09 dB | ✓ | Minimum | 20 |
| Distortion Margin (WB) | 10.09 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, WB) | 1.8 dB | ✓ | Tolerance curves | Floating Limits |

## ELEMENT Hearing-Aid Compatibility Facility

# DUT: A3LSMF966U

Type: Portable Handset
Serial: 1755M

**Measurement Standard:** ANSI C63.19-2019; ANSI/TIA-5050-2018

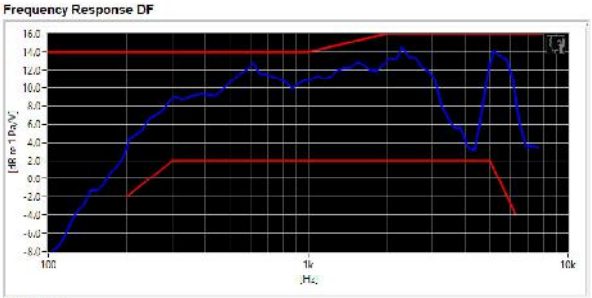
**Equipment:**

- Head and Torso Simulator: Bruel & Kjaer Model 4128 – SN: 1947220; Calibrated: 04/29/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

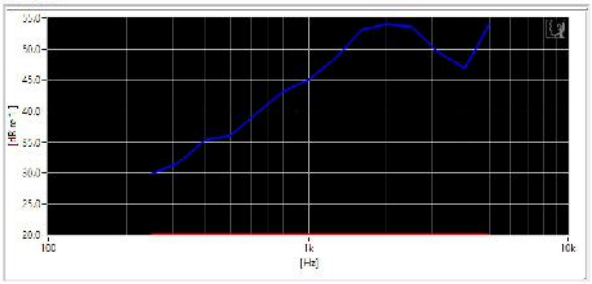
**Test Configuration:**

- Mode: NR n66
- Bandwidth: 40MHz
- Channel: 349000
- Codec Bandwidth: Wideband
- Mounting Force: 8N
- DUT Orientation: Folder Open

**Frequency Response DF**




**Distortion**




**Results DF**

| | | | | |
|---|---|---|---|---|
| Conversational Gain (IIN) | 14.80 dB | ✓ | Minimum | 6 |
| Distortion Value (WB) | 29.8 dB | ✓ | Minimum | 20 |
| Distortion Margin (WB) | 9.8 dB | ✓ | Tolerance curves | Absolute Limits |
| FR Margin (DF, WB) | 1.2 dB | ✓ | Tolerance curves | Floating Limits |

# 12. CALIBRATION CERTIFICATES

The Hottinger Brüel & Kjær Inc. Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770-209-6907
Fax: 770-447-4033
Website address: http//www.hbkworld.com

The Hottinger Brüel and Kjær Inc.
Service Center is Certified to ISO 9001:2015

# CERTIFICATE OF CALIBRATION
No.: 178939-101

## Calibration Of:

Model Number : 4128-C-001 Serial Number: 1947220

## Customer:

Element Materials Technology
7185 Oakland Mills Rd
Columbia, Maryland 21046

TK
5/6/24 ✓

## CALIBRATION CONDITIONS:

| | | | |
|---|---|---|---|
| Environment conditions | Air temperature : | 22 | °C |
| | Air pressure: | 98.3 | kPa |
| | Relative Humidity: | 47 | % RH |

## SPECIFICATIONS:

This document certifies that the instrument as listed under "Model Number" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurements. The calibration of the listed instrumentation was accomplished using a test system which conforms with the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Inc. Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The Instrumentation has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants

## PROCEDURE:

The calibration was performed according to procedure number : 4128 DP Rev. 7.21

## RESULTS:

"As Received" Physical Condition: Acceptable for Calibration

"As Received" Data: "As Received" = "Final Data" "Final Data": Within Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k$ =2 providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from standards, calibration method, effect of environmental conditions and any short term contribution from the device under calibration.

Date of Calibration: 29-Apr-2024

John Avitabile

Calibration Technician

Certificate issued: 29-Apr-2024

Meshaun Hobbs
Quality Representative

Hottinger Brüel & Kjer Inc. Calibration Laboratory

**RESULTS:**

Rev 7.21

I. Bruel & Kjaer Torso Model 4128-C-001, Serial Number: 1947220.

| As Received Data | | Final Data | | As Received = Final Data | X |
|---|---|---|---|---|---|

| | Acceptance Criteria | Actual |
|---|---|---|
| A. Speaker and Speaker Assembly Mechanical Check. | Pass/Fail | Pass |
| B. Protection Circuit | Acceptance Criteria | Actual |
| 1. 6.4 VRMS 750 Hertz Input | Signal remains for more than 30 Seconds | Pass |
| 2. 7.5 VRMS 750 Hertz Input | Signal disappears in 12 Seconds Pass/Fail | Pass |
| C. Ear Simulator | | |
| 1. See enclosed Calibration Results for 4158, serial number: 1886222 | Calibration Results Included Yes/No/NA | Yes |
| 2. See enclosed Calibration Results for 4159, serial number: | Calibration Results Included Yes/No/NA | N/A |

**Reference Standards:**

| Model | Serial Number | Trace Number | Cal Due | Interval (mo) |
|---|---|---|---|---|
| HP 3458A | 2823A03931 | 497514 | 30Nov24 | 12 |
| HP 5315A | 2032A04440 | 494379 | 31Jul24 | 12 |

The Hottinger Brüel & Kjær Inc. Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770-209-6907
Fax: 770-447-4033
Web site address: http://www.hbkworld.com

Calibration Certificate # 1568.01

## CERTIFICATE OF CALIBRATION No.: 178939-401



### CALIBRATION OF:

| Microphone: | Brüel & Kjær | Type | 4158/2669/UA1345 | Serial No. | 1886222/2025786 |
|---|---|---|---|---|---|

### CUSTOMER:

Element Materials Technology
7185 Oakland Mills Rd
Columbia, MD 21046

### CALIBRATION CONDITIONS:

TK 5/6/24 ✓

| | | | |
|---|---|---|---|
| Environment conditions: | Air temperature: | 22.7 | °C |
| | Air pressure: | 97.861 | kPa |
| | Relative Humidity: | 48.7 | %RH |
| Applied polarization voltage: | 200 Vdc | | |

**SPECIFICATIONS:** This document certifies that the instrument as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Hottinger Bruel & Kjaer Inc. utilizes a simple acceptance decision rule as defined by ILAC G8 with measurement uncertainty value which will not exceed 50% of the tolerance. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Inc. Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

**PROCEDURE:** The measurements have been performed with the assistance of the Hottinger Brüel & Kjær Inc. Microphone Calibration System B&K 9721 with application software WT9649 and WT9650 version 5.3.0.11 using calibration procedure: 4158-2669-UA1345-S251; III0108 Rev 01.12

### RESULTS:

- [X] "As Received" Data: Within Acceptance Criteria
- [ ] "As Received" Data: Outside Acceptance Criteria
- [X] "Final" Data : Within Acceptance Criteria
- [ ] "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k=2$ providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from standards, calibration method, effect of environmental conditions and any short-term contribution from the device under calibration.

Date of Calibration: May 1, 2024

Certificate issued: May 1, 2024

Can Phan

Meshaun Hobbs
Calibration Technician

Can Phan
Quality Representative

## Sensitivity

| | | | | |
|---|---|---|---|---|
| Nominal sensitivity: | -38 dB re. 1V/Pa | +/- | 2 dB | |
| Sensitivity at calibration conditions: | -38.30 dB re. 1V/Pa | or | 12.16 mV/Pa | |
| Sensitivity at reference conditions: | -38.33 dB re. 1V/Pa | or | 12.13 mV/Pa | |
| Uncertainty: | +/- 0.08 dB | | | |
| Correction factor K at reference conditions: | 12.33 dB | | | |
| Calibration Frequency: | 251.19 Hz | | | |

**Reference Conditions:**
Pressure: 101.3 kPa
Temperature: 23 °C
Relative Humidity: 50%

## Traceable references

| Type | Serial no | Cal. date | Due date | Calibrated by | Trace number |
|---|---|---|---|---|---|
| 4180 | 2602426 | 2023-02-10 | 2025-02-28 | DPLA | M2. 10-1562-2.1 |

## Condition "As Received":
Good

## Comments:
This Preamplifier predates the availability of TEDS.

**Acoustic Pressure Response Results ***

The results in this table are not covered by the current A2LA Scope of Accreditation *

| Frequency in Hertz | Sound Pressure Level in dB | IEC 711 Tolerance in dB | Actual Result in dB |
|---|---|---|---|
| 100 | -0.3 | ± 0.5 | -0.40 |
| 125 | -0.2 | ± 0.5 | -0.33 |
| 160 | -0.2 | ± 0.5 | -0.22 |
| 200 | -0.1 | ± 0.4 | -0.16 |
| 250 | -0.1 | ± 0.4 | -0.11 |
| 315 | -0.1 | ± 0.4 | -0.06 |
| 400 | 0 | ± 0.4 | -0.03 |
| 500 | Ref | Ref | 0.00 |
| 630 | 0.1 | ± 0.4 | 0.05 |
| 800 | 0.2 | ± 0.4 | 0.38 |
| 1,000 | 1.6 | ± 0.5 | 1.56 |
| 1,250 | 3.3 | ± 0.5 | 3.42 |
| 1,600 | 4.5 | ± 0.5 | 4.57 |
| 2,000 | 5.2 | ± 0.6 | 5.16 |
| 2,500 | 6 | ± 0.6 | 5.95 |
| 3,150 | 6.9 | ± 0.7 | 7.02 |
| 4,000 | 8 | ± 0.8 | 8.19 |
| 5,000 | 9.3 | ± 1.0 | 9.17 |
| 6,300 | 11.4 | ± 1.0 | 10.77 |
| 8,000 | 13.7 | ± 1.5 | 12.58 |
| 10,000 | 18 | ± 2.0 | 16.81 |

HBK HOTTINGER BRÜEL & KJÆR
The Hottinger Brüel & Kjær Inc. Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770-209-6907
Fax: 770-447-4033
Web site address: http://www.hbkworld.com

A2LA ACCREDITED
Calibration Certificate # 1568.01

## CERTIFICATE OF CALIBRATION

No.: 178939-701



## CALIBRATION OF:

| | | | | | |
|---|---|---|---|---|---|
| Calibrator: | Brüel & Kjær | Type 4231<br>IEC Class: 1 | | Serial No.: | 2343018 |

## CUSTOMER:

Element Materials Technology
7185 Oakland Mills Rd
Columbia, Maryland 21046

TK
5/6/24 ✓

## CALIBRATION CONDITIONS:

| | | | |
|---|---|---|---|
| Environment conditions: | Air temperature: | 22.4 | °C |
| | Air pressure: | 98.35 | kPa |
| | Relative Humidity: | 47.7 | %RH |

**SPECIFICATIONS:** This document certifies that the acoustic calibrator as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Hottinger Bruel & Kjaer Inc. utilizes a simple acceptance decision rule as defined by ILAC G8 with measurement uncertainty value which will not exceed 50% of the tolerance. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Inc. Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants. The acoustic calibrator has been calibrated in accordance with the requirements as specified in IEC60942.

**PROCEDURE:** The measurements have been performed with the assistance of Hottinger Brüel & Kjær Inc. acoustic calibrator calibration application Software version 2.3.4 Type 7794 using calibration procedure 4231 Complete

## RESULTS:

- [X] "As Received" Data: Within Acceptance Criteria
- [ ] "As Received" Data: Outside Acceptance Criteria
- [X] "Final" Data : Within Acceptance Criteria
- [ ] "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the calibrator under calibration.

Date of Calibration: April 29, 2024

Certificate issued: April 29, 2024

Can Phan
Calibration Technician

Meshaun Hobbs
Quality Representative

## Sound Pressure Levels

**All stated values are valid at environmental reference conditions**

| Nominal Level [dB] | Accept Limit Lower [dB] | Accept Limit Upper [dB] | Measured Level [dB] | Measurement Uncertainty [dB] |
|---|---|---|---|---|
| 94 | 93.80 | 94.20 | 93.99 | 0.12 |
| 114 | 113.80 | 114.20 | 114.03 | 0.12 |

## Frequency

| Nominal Frequency [Hz] | Accept Limit Lower [Hz] | Accept Limit Upper [Hz] | Measured Frequency [Hz] | Measurement Uncertainty [Hz] |
|---|---|---|---|---|
| 1000 | 999.00 | 1001.00 | 999.98 | 0.10 |

## Total Distortion*

**Distortion mode:** [X] TD* [ ] THD*

| Calibration Level [dB]* | Accept Limit [%]* | Measured Distortion [%]* | Measurement Uncertainty [%]* |
|---|---|---|---|
| 94 | 1.00 | 0.56 | 0.13 |
| 114 | 1.00 | 0.16 | 0.13 |

## Environmental Reference Conditions:

Pressure: 101.3 kPa, Temperature: 23 °C, Relative Humidity: 50%

## Instrument List

| Type | Description | Serial no | Cal. date | Due date | Calibrated by | Trace number |
|---|---|---|---|---|---|---|
| 3560 | PULSE Analyzer | 2723320 | 2023-10-19 | 2024-10-18 | GK | CAS-664166-V3L2K7-801 |
| 9545 | Transfer Microphone | 3 | 2023-10-31 | 2024-10-30 | MH | CAS-664166-V3L2K7-403 |
| 4228 | Reference Sound Source | 1618502 | 2023-04-19 | 2025-04-30 | WS | CAS-632564-L2S0L9-708 |

During the calibration the calibrator has been loaded by the load volume of the Transfer Microphone. The load volumes for a number of different types of Transfer Microphones are listed in the table below.
For Brüel & Kjær Pistonphones types 4220 and 4228 the result of the SPL calibration has been corrected to be valid for a load volume of 1333 $mm^3$ . For all other types the result is valid with the actual load volume.

| Transfer Microphone Type | Fulfils standard IEC 61094-1 LS | Fulfils standard IEC 61094-4 WS | Load Volume 1" (1/2" mic including DP-0776) | Load Volume 1/2" |
|---|---|---|---|---|
| 4180 | yes | yes | 1126 $mm^3$ | 43 $mm^3$ |
| 4192 | - | yes | 1273 $mm^3$ | 190 $mm^3$ |
| 9545 | - | - | 1333 $mm^3$ | - |

**Condition "As Received":** Good

# 13. CONCLUSION

The measurements indicate that the wireless communications device complies with the HAC limits specified in accordance with the ANSI C63.19 Standard and FCC WT Docket No. 01-309 RM-8658. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters specific to the test. The test results and statements relate only to the item(s) tested.

The measurement system and techniques presented in this evaluation are proposed in the ANSI standard as a means of best approximating wireless device compatibility with a hearing-aid. The literature is under continual re-construction.

# 14. REFERENCES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